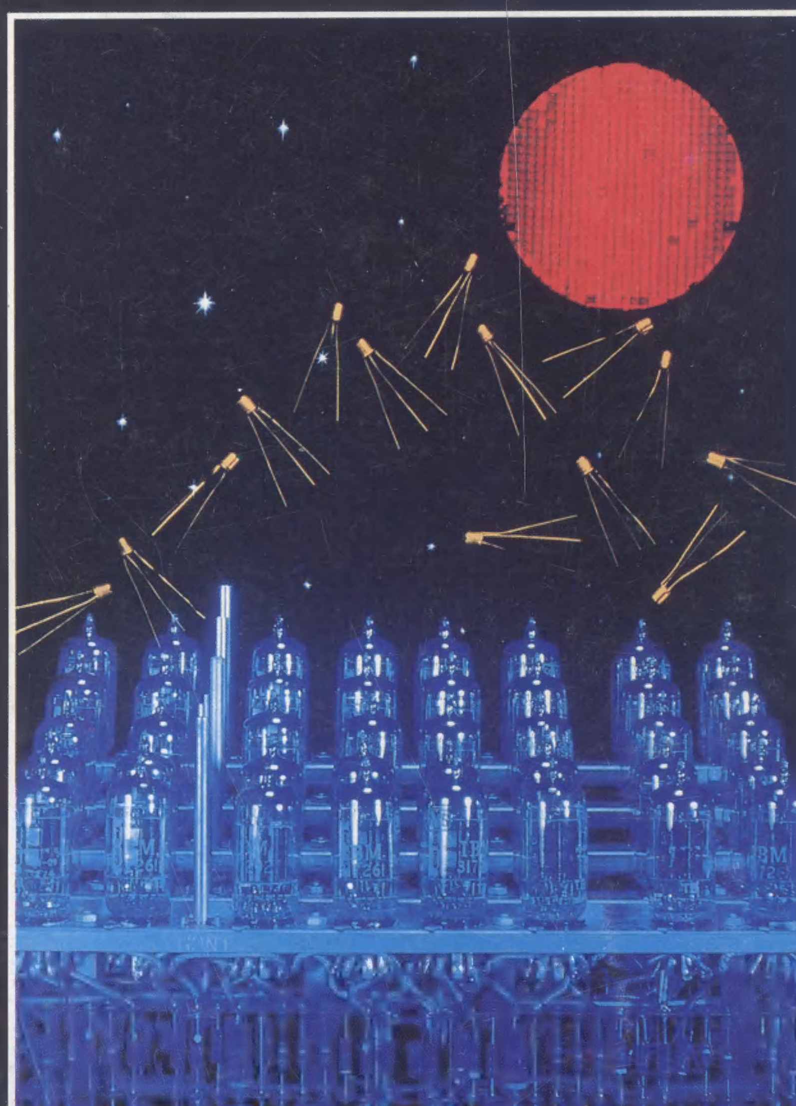
Think
January/February 1976



Fastest 25 Years

It was to have been the nuclear age. It became the computer age.

Center Section

Cover: A quantum leap forward in inventiveness is represented in this galaxy of electronic computer componentry—from vacuum tubes in the 1950s to transistors in the '60s, and the monolithics of today. The result: faster, smaller, more economic computers. And the opening up of new frontiers for their use.

Letter from the Chairman

How IBM is celebrating America's 200th birthday

Before our nation's 200th birthday celebration gets into full swing, I want to bring you up to date on what IBM is doing to honor this important milestone.

The Bicentennial is a time not only for celebration, but for reflection on our history and our aspirations. In our Bicentennial program, we hope to highlight some of the national, international, and cultural contributions that have helped shape America.

In keeping with this objective, "The World of Franklin and Jefferson" opens at New York's Metropolitan Museum of Art on March 5 after a year-long tour abroad. The exhibition was designed for the American Revolution Bicentennial Administration by the Office of Charles and Ray Eames, with the cooperation of the museum and a grant from IBM. It was warmly received in Paris, Warsaw, and London.

In January, I had the pleasure of hosting a preview of "America on Stage" at the John F. Kennedy Center in Washington, D.C. This IBM-sponsored exhibition focuses on the role of the performing arts in recording and replenishing our heritage.

These are our two major Bicentennial activities. But we have also sponsored a European tour by the New York Philharmonic Orchestra, and we are providing support for special Bicentennial activities planned by the cities of Boston and Philadelphia. On July 4th, with the help of grants from IBM and other corporations, 200 early and modern vessels from 30 countries will sail up the Hudson River as part of "Operation Sail."

IBM's Bicentennial program is intended to express our gratitude for the opportunities afforded by a free society.

I hope you and your families will be able to see and enjoy some of these events during the year.

Frank Cary

Think

Volume 42 Number 1
January/February 1976

Features

4

The hotly contested world of IBM Japan

They call it a "sunrise" industry and the competition is forming up.

Determined that Japanese computer manufacturers will have their place in the sun, the Japanese Government is subsidizing their efforts to compete successfully in both home and overseas marketplaces.

For IBM Japan, long an innovative leader in the industry, the challenge is sharp and clear. "The good old days are gone," says Takeo Shiina, the company's 46-year-old president. "Now we have to create good new ones."

10

What a year!

In both the U. S. and abroad, marketing turned a bad year into a good one for IBM.

14

GBG goes global

For the General Business Group, a new marketing mission.

Small systems and office products—they're IBM's fastest growing business. Now a new worldwide organization plan for the General Business Group has come into place. Its aim: to respond more directly and rapidly to what's happening in the marketplace. It's a timely move because a lot is happening out there. The needs and expectations of customers seem to grow almost overnight. So do the ranks of competitors.

CENTER SECTION

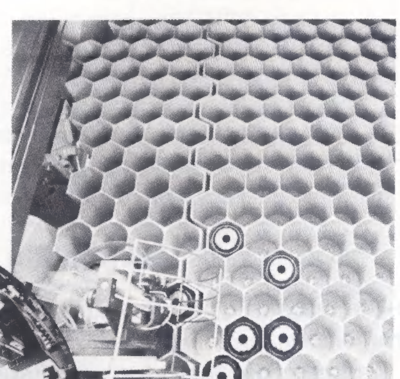
Fastest twenty-five years

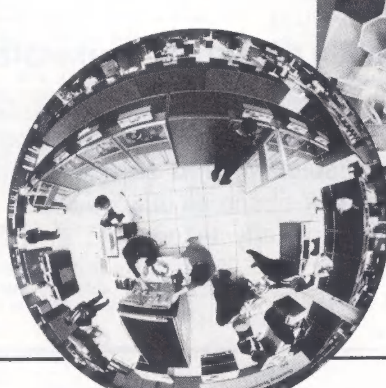
It was to have been the nuclear age. It became the computer age.

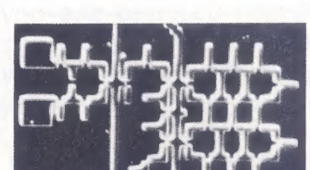
The exciting story of how IBM computers evolved into what they are today through a quarter-century of technological innovation.

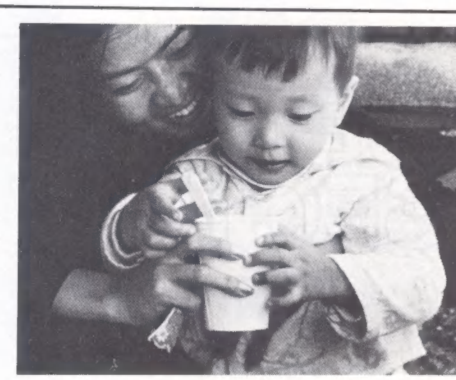
From vacuum tubes in the 1950s to the microscopic monolithics of today's System/370, computers have come farther, faster than almost any other form of technology. It was only twenty-five years ago that computers were little more than a scientific curiosity. Today, they are indispensable to the modern work-a-day world.

This easy-to-read illustrated center section is produced as a companion-piece to a brand-new exhibit in IBM's 590 Madison Avenue windows that's called "The Evolution of IBM Computers." See it next time you're in New York.









Next issue:

Our mixed economy

Cold war? Coexistence? Or is it détente—in the give-and-take between business and government in the hybrid economy of the U. S. Part V of the series on business and how it works. With Walter E. Heller, former chief economic adviser to President John F. Kennedy.

Something new in the marketplace

It's GBG/I—for General Business Group/International—the new organization guiding the marketing, manufacturing, and service of GSD and OPD products in 17 countries outside the U. S. A report on how it has already taken hold in the international marketplace.

Letters

Zero population

Malcolm Muggeridge's article, "How not to say what you mean," in the November/December *Think* Magazine, was a welcome sight. Too often, through pomposity, haste, or just plain laziness we turn out written matter that is embarrassingly bad. Even *Think* Magazine is no exception! On page 21 of the same issue, in an article commenting on the exploding rate of increase in the human population, surely your copy editor did not intend what actually appeared in print: "Only in West Germany has population declined to zero. . . "

Gilaine Shindelman
New York, N.Y.

Think JANUARY/ FEBRUARY 1976

Think is published by International Business Machines Corporation, Armonk, New York 10504. Frank T. Cary, Chairman of the Board. It is produced by IBM Corporate Communications, J. R. Young, IBM Director of Communications. *Think* is distributed to all employees in the U.S.A., and to a number of IBM employees abroad.

Credits: Cover: Mitchell Funk. Inside front cover: Joan Sydlow, *Business Week*. Joe Barnell: 24, 25. Rene Burri-Magnum: 31. The Chartmakers: 16. Paul Fusco-Magnum: 28, 29. Georg Gerster-Rapho/Photo Researchers, Inc.: 4, 32. IBM Canada: 9. IBM Japan: 6 top, 7, 8. IBM Photo: 30. Paolo Koch-Rapho/Photo Researchers, Inc.: 6 bottom. Bob Lerner: 14 left, middle, bottom. Official White House photo: 13. Charles E. Rotkin-pfi: 26, 27. Manny Rubio: 14 right. Arthur Schatz: 10, 18, 19. Walter Wszulkowski: 17.

Special Section: Mitchell Funk: 1, 2 top left, 3, 4, 5, 6 middle, 7 top and middle, 8, 9, 10 top, 12, 13, 15, 18, 19, 20 top right. NASA Photos: 11 bottom right, 14 bottom. Remainder: IBM Photos.

Rhetorically speaking

I disagree with Mr. Muggeridge's condemnation of rhetoric as "the sickness of words" [Nov./Dec. '75 *Think*]. Rhetoric's purpose is not solely "to arouse or impress." It can be an effective method of expression. It can lend grace and elegance to the language. It has the power to evoke such images as a "technological mandarin," or a "verbal sleepwalking," or "fingers danc(ing) over a keyboard as though in a trance"—all Mr. Muggeridge's rhetorical attempts to convince me rhetoric is to words as the Dutch elm disease is to trees. Rhetoric may be a degree of obfuscation: and its overabundance may suggest fraudulence, but without it, articles such as this would read as technical manuals—dull and lifeless; lacking conviction. Would "hoist by his own petard" obfuscate my point?

David E. Westphal
Moss Beach, Calif.

Recommended reading

Reference: *Think,* Nov./Dec. '75, "Brother's keeper?" by William Longgood. I must comment on Mr. Longgood's allusion to abortion as part of the solution to the world's "over-population problem." Who can say for sure that there is a population problem? Certainly not Mr. Longgood. Does he know something that God, the Creator of us all, doesn't know? For after all, doesn't God still have a hand in creation? Would He create more than He can care for? I recommend for Mr. Longgood's reading, and for anyone else who goes around spouting "over-population," *Luke* 12:13-31, and *Luke* 8:22-25. These passages have to do with faith, something lacking in those who overwork the so-called "over-population problem."

Richard T. McGann
Wheaton, Md.

Concrete evidence

Your article in November/December issue of *Think* Magazine titled "The brick and mortar of IBM" is a very excellent communication. Articles of this type have reinforced IBM's Corporate Architectural image and have made my job a lot easier.

As the site architect at Manassas, I have the responsibility for representing the "Corporate Image" point of view as well as architectural code requirements . . . The *Think* article helps make clear the point about IBM's image to the outside world.

D. B. Dallman
Manassas, Va.

Anything can happen

I'm a young industrial engineer, working for [an] IBM Argentine branch. I've read your article, "Growth" in *Think,* July/August '75. Though by no means an expert on the subject, there are a few facts that I should like to point out.

There are numerous factors to limit the mad growth of population . . . Pollution, energy, water, food, are only a few of these factors. Any of these, though, can be a "von Liebig minimum" when the moment comes.

Now, to determine how crucial these problems are, let us suppose that the first "von Liebig minimum" will come about through pollution . . .

Let us suppose, too, that we can find a solution to avoid running into the corresponding "von Liebig line." It is obvious, however, that after the von Liebig pollution line, we shall have the water line, the food line, etc. It's something like having a chain, whose links break one after another . . . and we shall have to strengthen them, too . . .

The point that I'm trying to make is that . . . we must not only deal with all the possible complications concerning our population, but (worse still) accept that there may be new necessities that we haven't even thought of yet . . .

Paul Edward Kersman
Buenos Aires, Argentina

Think welcomes letters from readers, commenting on articles or offering suggestions and criticism. Write to:

The Editor
***Think* Magazine**
7-11 South Broadway
White Plains, N.Y. 10601

by Ed Grimm

The hotly contested

world of IBM Japan

Japan's supply of oil is cut off by war in the Middle East. After 200 days of petroleum drought, the government collapses, millions starve, and the economy begins to self-destruct. Incredibly, the nation pulls through, and all ends well. That's the plot of a best-selling novel called *Yudan!* which has sold 300,000 copies and will soon be a motion picture.

Yudan! (which can be translated as *Oil Cut!*) may be fiction, but the Japanese public's fascination with it stems from the very real awareness of the nation's dependence on outside forces and events. For an insular land like Japan, this is bitter tea—especially coming in the wake of its postwar economic heroics.

In Gross National Product (the total output of goods and services), Japan trails only the United States and Soviet Russia. Her annual growth rate throughout the 1960s was 15.6 percent. Her progress is also mirrored in social indicators like the lowest infant mortality rate in the world, an average life span that now exceeds Scandinavia's, and a 99 percent literacy rate for her 111 million population.

It has been an immensely bullish era. That's why the current slowdown is so hard to take. As one Japanese journalist puts it: "It's like hearing one of your favorite records suddenly being played at many fewer revolutions per minute. It's unpleasant and unnerving."

For IBM Japan as well, this is a time of diminished growth and sober reassessment—although, by closing strongly last year, the company was able to record a significant revenue increase over 1974. The energy crisis has been reflected in cutbacks in some indoor and outdoor lighting; and economy measures have included the consolidating of imported parts into weekly charter flights, at a saving of $1-million.

The computer industry has fared better than many another in an economy that has flip-flopped from high inflation (24.5 percent) to a recession bringing the first decline in GNP in 30 years. And this relative health of the computer industry—combined with the government's determination that Japanese manufacturers will thrive within it—has brought other pressures to bear.

"Slower growth and more formidable competition—these are our two greatest concerns," says Takeo (Tak) Shiina, IBM Japan's 46-year-old president. "The good old days are gone. Now we have to create good new ones."

"The good old days" were not that long ago. They began after the war and peaked in the 1960s and early 1970s. Since 1950, when the company was reorganized as IBM Japan, Limited, its rate of growth has been vigorous, while the number of employees has risen from 66 to almost 11,000. It is Japan's largest exporter (to 57 countries) of data processing equipment, and it ranks twelfth of all companies in Japan in corporate income taxes paid.

IBM Japan has also gained a reputation as an indefatigable innovator—a role that has brought recognition for advanced applications in shipbuilding, steel production, broadcasting, and banking. In 1974, the company received the prestigious Ishikawa Prize for the publishing system used by two major newspapers (*see accompanying story*).

In the spring of 1975, the Japanese Government's Blue Ribbon Medal was awarded Sanae Inagaki, chairman and chief executive officer of IBM Japan, for his many years of contributions to the prosperity and development of the nation's computer industry. "Our customers," says Inagaki, "have much knowledge and experience in a full variety of computer applications. Their capability is one of the highest levels in the world."

Tak Shiina likens the developments in computers to Japan's automobile industry.

"In 1949, when the only automobiles on the streets were U. S. military jeeps and trucks, the government published a white paper that selected automobiles as a key postwar industry. It subsidized technology and production through low-interest loans.

"Quotas were put on imported cars, and by 1960, names like Datsun and Toyota had replaced Renault, Austin, and Hillman. Then, in the early 1960s, the government urged certain companies either to merge or align themselves with Toyota or Nissan. The government was now satisfied that the Japanese manufacturers were strong enough, so they began to allow foreign capital to operate more freely."

This liberalization is now taking place in the computer industry, after a comparable chronology of events. The key year was 1972, when six Japanese computer manufacturers formed three groups to pool their research and development re-

---

Japan's economy may be in the trough of a wave right now, but IBM Japan has maintained its standing within the top ten revenue-producing countries of IBM World Trade. The combined income of these countries helped mightily in pushing IBM's overseas revenues ahead of its U. S. results for the first time last year.

The top ten, listed alphabetically: Belgium, Brazil, Canada, France, Germany, Italy, Japan, the Netherlands, Switzerland, the United Kingdom.

Like this rooftop carpenter, the Japanese are busy these days retooling a sputtering economy. And looking to the computer industry to lead the way.

sources. Now these three have become two. The intent: to centralize even further the government-backed effort to develop new technology for the home and overseas markets.

In December 1975, liberalization, which had proceeded in stages from 1972, was completed. All remaining controls were lifted on foreign capital investment in the production, marketing, and rental of electronic equipment. Restrictions are gone now, too, on the importing of foreign-made mainframe computers, memory devices, terminals, and components. In April, the software industry will also be completely liberalized.

From the Japanese point of view, liberalization is the right decision at the right time. The hope is that other countries may be equally receptive to the entrance of Japanese computers. Since they do not require large quantities of raw materials in their production, computers are seen as a highly desirable "knowledge-intensive" export by Japan's Ministry of International Trade and Industry (MITI); and their overseas potential is deemed enormous.

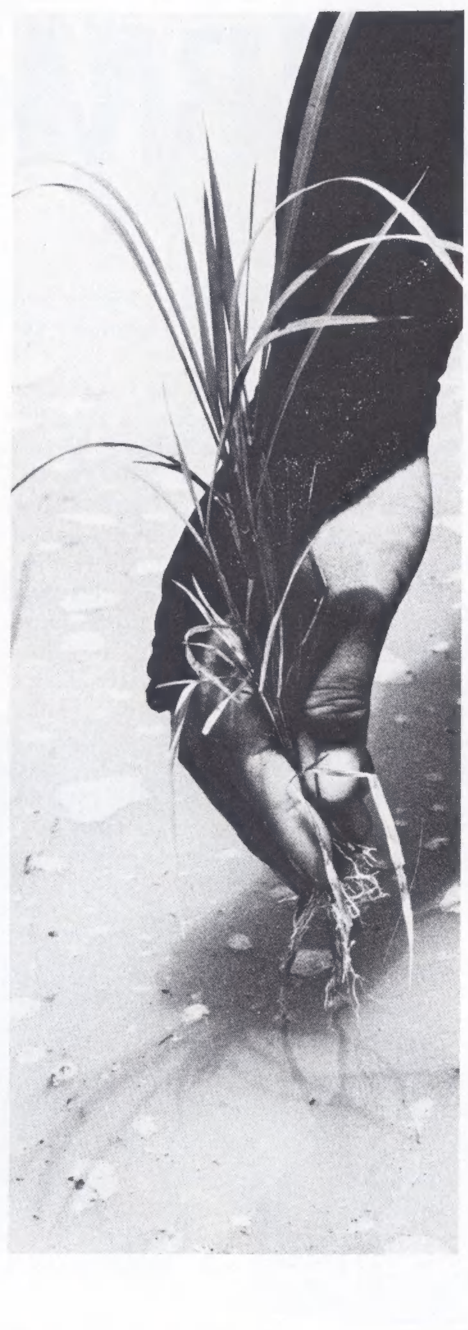
In short, the computer industry is considered—as the Japanese put it—a "sunrise" and not a "sunset" industry. And it is the "sunrise" industry that the Japanese government traditionally nurtures.

"What the government really does," explains Shiina, "is to map out a long-range strategy. Companies in the industry follow these guidelines, but they also continue competing with one another. In order to get the government's help, and not be left out of the running, a company must demonstrate strength and promise."

Here is how the JCMs (Japanese computer manufacturers) line up today:

• Fujitsu: One of IBM's major competitors outside the United States; has opened sales agencies in Brazil, Spain, Korea, the Philippines, and Australia; owns a subsidiary in California; and has entered into an agreement with Amdahl

"Tomorrow is never assured," says IBM Japan President Takeo Shiina, who believes that computers can help his nation "pull free of our recession." Below, one root of the problem: Less from the soil means that more of Japan's food needs must be paid for as imports.



Company in the U. S. for whom it is now manufacturing and exporting computers.

• Hitachi: Large manufacturing enterprise, with 77,000 employees; has recently entered into a cross-licensing agreement with Motorola covering microprocessors.

Fujitsu and Hitachi, who are financially backed by MITI, are jointly manufacturing the M series computers, which are increasingly competitive with IBM products.

• Nippon Electric (NEC) and Tokyo Shibaura Electric (Toshiba): Large manufacturers who have jointly introduced ACOS computers to Japan; in addition, NEC exports small computers to Australia and has a small systems lab in Boston, Mass.

• Mitsubishi Electric and Oki Electric: Introduced the COSMO series; market very small computer systems and peripheral equipment both in Japan and worldwide.

Following MITI's recent guidelines, Fujitsu, Hitachi, and Mitsubishi are now working together on research and development of large-scale integrated circuits; Toshiba and NEC are launched on the same effort. Oki, meanwhile, is concentrating on the development and manufacture of terminals.

"The time of a genuine test is rapidly approaching," comments the *Japan Economic Journal.* Industry observers see three tests the JCMs must pass: the ability to market overseas; the confidence to operate without government subsidies; the development of improved technology.

There is much to be gained from passing those tests. During the last 10 years, the Japanese computer industry has expanded by 36 percent annually; and a 30 percent growth rate is projected through 1980. Total hardware and software sales are four times what they were in 1971. The government is determined that the home companies—liberalization notwithstanding—shall have at least 50 percent of this expanding business.

What of IBM Japan's reaction to all this

(Continued on page 8)

Tokyo commuters catch up on the day's news. Japan's "information flood" must satisfy a nation with a literacy rate of 99 percent. More than 90 newspapers are read daily by 40 million Japanese.

Subways are for reading

Japan's shifting economic fortunes and the events behind them are reported to the Japanese public by a press noted for its multiplicity, its wide circulation, and its nationalism.

The headlines of 1975 were not the happiest for Japanese newsmen to write or readers to scan. They told of rising unemployment and falling stock prices. Articles reported on the government's anti-recession programs, and quotes of hopeful economic observers often seemed refuted by new developments before the ink on them dried.

News of the changing computer industry was part of the picture, too, especially in the business press. Coverage of the steps in liberalization was extensive in publications like the *Japan Economic Journal,* an English-language weekly, and the *Nihon Keizai Shimbun,* considered the nation's equivalent of *The Wall Street Journal.*

Press comment on IBM Japan continued to be largely favorable. The company is portrayed as a responsible *gaishi* (foreign-owned) organization and a leader in its industry. In its dealings with the press, IBM Japan is criticized for its conservatism but commended for its veracity.

Japanese newspapers have not been immune to the same economic slump they are recording. Although circulation remains high (40 million) and the number of papers constant (91 national, regional, and local publications), labor and production costs are inching up steadily.

Accordingly, many papers are looking hard for ways to increase production efficiency. Two of them—the *Nihon Keizai Shimbun* and the *Asahi Shimbun,* Japan's largest newspaper with a 6.52 million circulation—have found one in the Japan Publishing System, developed jointly with IBM Japan and IBM's Federal Systems Division. This on-line computer system is used for editing, proofreading, typesetting, and page composition. In 1974 it received the Ishikawa Prize, which is awarded each year in Japan for major scientific achievements.

Technology may change, but the editorial policies of Japan's newspapers do not. The press views itself more as a transmitter than interpreter of events. If a paper does disagree with a new government policy, it questions rather than criticizes; and the questions it raises often help achieve a national consensus on the subject.

The taps that turn on the flow of news in Japan are the press clubs. These associations of reporters are assigned to government ministries (MITI has two), political parties, business firms, and other organized groups. Each club is the exclusive "beat" of reporters assigned to it. The Bank of Japan Press Club, for example, includes reporters from 14 selected Japanese media whose specialty is finance and insurance.

Japan's magazine scene is decidedly more freewheeling. There are 1,405 monthly and 56 weekly magazines with a combined circulation of 222.4 million. Two of the major business magazines are *President* and *Nikkei Business.* Unlike newspapers, which are subscribed to monthly, magazines compete strenuously for newsstand sales. Each year, new publications come and go like calendar leaves.

Japan has seven national television networks, with 80 percent of the programming of Tokyo origin. There is little coverage of business. Last November, however, IBM Japan President Takeo Shiina made his TV debut, discussing the computer industry on *Studio 102,* a program covering public affairs.

Scientists in Tokyo ask, 'What's in it for Japan?'

Joji Iisaka's world is a world of images—not the ones that emerge from the delicate tracery of a *haiku* poem, but those that reveal on TV-like display screens the secrets of the human body or the stars.

Iisaka is a staff member of IBM Japan's six-year-old Tokyo Scientific Center (one of ten which IBM operates outside the United States). His specialty is image processing, one of four areas in which the center is exploring new uses for data processing. The other three: environmental control, computer-aided design, and numerical linguistics. The results of such explorations will help deepen Japan's sense of the capabilities of data processing.

"Pictures are the best way to communicate," Iisaka believes. "A mathematical formula may be a good tool for the scientist, but it is not a comprehensive explanation of an idea for anyone else. But if we can *show* a circle and let people almost feel its shape, we can transfer a concept much more easily."

His work has included the detection of cancerous cells and abnormal chromosomes, an analysis of steel's structural qualities, the genetic effects of drugs and food additives, the tracking by isotopes of tumors and heart ailments, and the movement of stars. In each case, data processing equipment helps serve as a set of supersensitive eyes for scanning and analyzing visual images.

Now Iisaka has begun work in remote sensing. The effort here is, through low-altitude, infra-red photography, to compile a data base on Japan's land mass and surrounding waters—even to the detection of underwater volcanoes.

Joji Iisaka's background is in physics, which he feels, like Latin, is a solid base for other learning. "It's a bridge," he says, "and, in a way, the computer is like that. Often the technique that works in something like medicine can lead to a solution for a problem in electronics or oceanography."

His colleagues at the Tokyo Scientific Center are also working on vital projects of their own. They include Hyogo Dynamics, an approach to regional planning that relies on projections rather than the analysis of past trends; the development of a computer model for air pollution patterns; a comprehensive study of Japanese grammar; and computer-assisted ship design.

"Our job is to serve research," says Joji Iisaki of the IBM *Japan Scientific Center. His specialty: image processing.*

(Continued from page 6)

ferment? "In our industry," says Tak Shiina, "tomorrow is never assured. What we must do is to keep delivering customized solutions to problems. The more we can do this—especially through the development work being done at our Fujisawa lab—the more success we'll know.

"You know, it's interesting. Before the energy crisis, customers used to ask questions like, 'What happens if my plant doubles or triples its capacity?' Now instead of long-range planning, they're looking for productivity improvements to help them get through the year.

"People realize that it's the qualitative measures that are called for now—and not unbridled quantitative expansion. Here is where the computer can really contribute to Japan's prosperity and help us pull free of this recession."

The deepest point of the recession was February 1975, but recovery since then has been frustratingly slow. The government is priming the pump in industries like public works, housing, and pollution control. "Anti-recession packages" contain increased benefits to furloughed workers as well as loans to promote exports and forestall bankruptcies—which reached an all-time high last November. And still there is scant evidence of reviving consumer or investor confidence.

New orders for machinery are down, corporate profits are 40 percent beneath the previous year's, shipbuilders have been rocked by the shrinking demand for oil tankers, and steelmakers have cut back by shutting down furnaces for repairs ahead of schedule. Industries like petrochemicals, paper pulp, textiles, and electric machinery have all suffered. Only automobile sales have been high—and for a reason: The public rushed to buy cars in the months before December, when government-decreed emission controls drove prices up.

Japan's lack of natural resources has escalated from problem to dilemma. She must import 99.7 percent of her crude oil

needs, and 98.9 percent of her iron ore ("the rice of industry"). In an effort to escape the vise of rising oil prices, she is stringently conserving energy, and drilling for offshore oil in the Bay of Bengal. Nuclear energy might be an answer, but there are worries about radioactivity. So that industry is lagging.

As for food, the body's fuel, in 1960 Japan produced 83 percent of her grain consumption. But the exodus of farmers to the cities swelled, and today Japan must import 60 percent of her grain needs.

Indications of whether the economy is reviving or not form a kind of checkerboard pattern, the bright patches alternating with dark ones:

- Jobholders number about 52 million, some 2.4 million more than last spring. But the unemployment rate of about 2 percent is high—for Japan.
- The balance of payments deficit narrowed from $798-million in October to $401-million in November. But the deficit still exceeds 1974's; and the yen is at its lowest value since the official rate of exchange was set four years ago.
- The nation's labor force settled for a small wage increase last spring to help fight inflation. But a walkout last November by 860,000 government workers seeking the legal right to strike raises the prospect of a tough negotiating stance this spring.

All things considered, however, many Japanese feel that the economic slowdown may be a blessing in disguise. They believe the country was so keen on "catching up with the West" that its focus grew too inward. The oil crisis and the spillover effect of other nations' recessions changed all that. Says Prime Minister Takeo Miki: "The Japanese now realize—though grudgingly—that there are limits to the kind of economic expansion we experienced in the past."

Japan remains confident, if impatient—like a normally healthy person anxious to throw off a persistent virus infection. MITI foresees other industries joining computers in the ranks of the robust and is projecting an annual growth rate of 7 percent from 1977 to 1980. On this basis, it is likely that Japan will lead the world in per capita output.

And then there is this automobile-journey analogy by Hidetoshi Kato, a sociologist: "In 1945, we restarted our ignition, and the engine began to turn over. Ten years later, we shifted from first to second gear, and since then we've been shifting gears upward every five years. Now I think we can downshift to third or even second gear and drive quite comfortably at a lower speed with more time to enjoy the scenery." ■

When the Board goes abroad

When members of IBM's Board of Directors convene for their monthly meeting, the agenda is always international. Sometimes the location is, too.

Periodically, the Board, which usually meets in Armonk, New York City, or occasionally at a U. S. plant site, travels to one of the major countries of the world where IBM does business. There they meet jointly with the IBM World Trade Europe/Middle East/Africa or Americas/Far East Board of Directors and with country management. Most recently, the Board met with directors of A/FE and IBM Canada in Toronto last September.

The aim in all instances is to get a first-hand look at IBM operations, to meet with local management, and to exchange views with national leaders in government and industry.

The practice began in 1960 with visits to Paris, Milan, Amsterdam, and Sindelfingen. Over the years, trips have been made to Japan, Brazil, the United Kingdom, and Switzerland.

Occasionally, the three-man Corporate Office will travel overseas for its own fact-finding and impression-gathering needs. This was the case last October, when IBM Chairman Frank T. Cary, Vice Chairman Gilbert E. Jones, and President John R. Opel flew to Italy for a meeting with the E/ME/A Board and the European Advisory Council.

The Corporate Office's trip to Italy also included visits to IBM Italy's new headquarters and education center, as well as a briefing on its scientific centers, and business prospects. ■

Last year's joint Board meeting in Canada included this visit to the GSD plant in Don Mills. From left: IBM Directors Dr. Harold Brown and Maersk Mc-Kinney Moller; IBM Treasurer Bertram H. Witham; Leo Kilcoyne, director of manufacturing, GBG—Canada; A/FE Director Thomas J. Bata; IBM Chairman Frank T. Cary; Brian Canham, quality engineering manager, GSD plant; Jim Montgomery, manufacturing manager, IBM Canada.

WHAT A YEAR!

In both the U. S. and abroad, marketing turned a bad year into a good one for IBM

by Geoffrey D. Austrian

She's all smiles now, but through May, OPD *Marketing Rep Linda Williams, of Austin, had made only a discouraging 15 percent of quota. She came back strong, won the office "mug of the month" twice for outstanding sales performance, and wound up the year making the Hundred Percent Club.*

'Retail Chain and Auto Sales Increase'

'Weekly Steel Production Climbs'

'25% Housing Gain Is Foreseen for 1976'

John F. Akers read the headlines from that morning's business pages of *The New York Times* to the early morning kickoff meeting. "For the first time in a couple of years," the president of the Data Processing Division told the members of the Westchester/Poughkeepsie branch office, "the economy may be on our side."

Or, as Branch Manager Ursula Farrell, now DPD's manager of large systems product marketing, said: "There's nothing like selling when somebody's buying."

As IBM marketing teams headed off into a new sales year—most carrying higher quotas and tougher marketing objectives—their mood was definitely upbeat.

One big reason: They had survived what was widely regarded as the worst business year since the Great Depression. And, as *Fortune* reported in January, it had become certain in recent weeks that the recovery was not running out of steam. For business in general, 1975 wasn't even a nice place to visit. For most companies, profits plummeted from the record levels of the years before. Unemployment peaked at 9.2 percent in May and retreated only slightly. Gross National Product in the first three months plunged at an annual rate of 9.2 percent—the steepest drop in 30 years. Bankruptcy filings were the highest ever.

How did IBM's marketing people fare in an environment that can be described as little short of traumatic? Surprisingly well. The marketing divisions either surpassed, made their objectives—or came within a hair's breadth of doing so.

The picture, of course, varied. Elementary and secondary school sales of Science Research Associates' products were impacted severely by slashed school budgets. Yet, SRA's college division recorded record revenues, up almost 15 percent over 1974. The Federal Systems Division, celebrating its twentieth anniversary, turned in its best sales year ever. The challenge for '76, FSD President John B. Jackson told a management meeting in early January, was to maintain the momentum. "The healthy position of FSD," he said, "is indicated by the fact that the division enters 1976 with the largest beginning-of-the-year backlog in our history. This reflects success in previous years in winning long-term programs in such diversified areas as Navy Sonar, NASA's Space Shuttle, and in the major avionics programs of the Navy and Air Force."

In some instances, it appears, IBM people and products did well because they helped overcome the effects of the recession. Customers discovered that the company's products and techniques were the best means of cutting costs and raising productivity. In other instances, marketing reps had to take the roller coaster ride along with the economy—but came back strong. "The day my manager gave me the computer printout saying that I was at 15 percent of quota for the year, you can imagine how I felt," says Linda Williams, a marketing rep with the Austin, Texas, branch of the Office Products Division. "I kept asking myself what was I doing wrong? Was it the economy or was it really me? Did I belong in the business?"

That was early June. By the end of the month, Miss Williams, who had never seen a really bright month since going on quota two years ago, had won her office's "mug of the month" award for the best balanced performance in selling the wide range of OPD products. She captured the award again in November, and wound up the year by making the Hundred Percent Club.

"There was no way I was going to give up without succeeding," she says.

In all, the company's major marketing units turned in a gratifying performance. Some highlights:

- *Data Processing Division* moved through the year almost as if there had been no recession, bettering quota for 10 straight months and exceeding its major selling and installing objectives for the year.
- *General Systems Division* set an all-

time new accounts record for IBM, reaching customers who had never been able to seriously consider having their own computers before.

▪ *Office Products Division,* after getting off to a slow start in the first half, roared ahead, aided by the introduction of three new products—the 6:5 line of dictation equipment, the Electronic Selectric Composer, and the Mag Card/A Typewriter.

When the going got tough, IBM people in the field didn't sit around waiting for instructions. "You make your own decisions where to put your time, where to put your efforts, where to put your money," says Rick Anderson, an advanced marketing rep in OPD's Little Rock branch. In Arkansas, where unemployment reached as high as 28 percent in some counties, the Little Rock office found itself in "terrible shape" at the close of the first quarter, according to Branch Manager Bob Jones. "We were at 58 percent of our total branch quota. Keyboard products—Mag Card, Mag Tape, and Memory Typewriters—were even worse. Copiers were coming out faster than we could put them in."

At the Hundred Percent Club in April, members of the branch found they weren't in that boat all by themselves. "Other people had worse stories than we had," says Marketing Manager Don Majors.

Reviewing the economic situation, OPD President Bart Stevens commented: "Years like this cause many organizations to withdraw—to stop investing resources in the future. I want to assure you that that's not part of the OPD strategy or plan —go out and sell."

Back in Little Rock, members of the office decided to take the president at his word.

"We had four Memory Typewriters installed in the office as demonstrators," says Majors, "but nobody was coming in to see them. So we got ten more, put them under our arms just like we do regular typewriters, and took them out to customers' offices.

"We would move right into a heavy typing station, sit down and work with the secretary to boost her output."

In March, Memory Typewriter quota stood at 24 percent. "We came out of the chute at 150 percent in May," says Jones, "shot to 231 percent in June and 342 percent in July." At the close of the year, the figure stood at 134 percent for the full year.

Who bought the machines? Small insurance agents. Local bankers. Even some small-town lawyers. "All of our business is small business," says Jones.

The office wound up the year by making balanced performance, for the fifth year in a row, as well as the Club.

The story was repeated elsewhere.

"We shipped some five to six hundred extra Memory Typewriters to the field," says Jim Riley, manager of product planning, advanced products.

"In June, we had 1,000 machines in the warehouse we couldn't sell. Twenty days later, they were gone, and delivery time had reached 22 weeks."

The course for OPD was upward for the rest of the year. "Our people had gone through so much, their skills were so sharp, that they were anxious to get out there," says Jeff Malley, manager of the Austin branch. Plants, laboratories, everyone pitched in. Besides keeping customers satisfied, OPD customer engineers kicked in one month's sales quota through a new awareness program.

While they experienced somewhat less of a cliff-hanger, GSD marketing people also came from behind to conclude a successful year. "By the end of the third quarter, our prospects for making year-end objectives looked very remote," C. B. (Jack) Rogers, Jr., told his division's kickoff meetings. In a final burst of energy, GSD sales reps brought in 3 million points. And, in the same scant 90 days, GSD customer engineers installed more than half a year's work load. The effort lifted the division over its net sales and installation quotas. But the real excitement was new accounts.

They were nearly double 1974's record number.

"We came out in January with a product that was affordable to the small-business man," says Marketing Rep Jim Dixon of GSD's Birmingham, Ala., branch. He is speaking, of course, of System/32.

"Customers wanted to know, 'Do I have to have a programmer to install the system?' " says Dixon. "They didn't because of the Industry Application Programs [IAPS] developed for the system." Out of the 13 new-account System/32s installed, 11 were put in with IAPS.

One customer, a small construction company that employs 22 people, has only one person in its office—the president's wife. "She decided she would rather put in the computer than hire another employee," says Dixon. "She made the decision, not her husband.

"He told me that if I kept Momma happy, he'd buy it, and she signed the order." The firm had formerly rented time on a bookkeeping machine that it shared with another customer. Now, it is doing payroll, job costing, accounts-payable, and general ledger accounting on its System/32—the same jobs that a larger company does.

At another company, the president learned to use the equipment, explains Dixon. "He said he didn't want to have any piece of equipment in the house he couldn't run himself."

Over in Huntington, W. Va., a sub-office of the GSD Columbus, Ohio, branch, Marketing Rep Bob Nicholas sold 15 new accounts, 11 of them System/32 customers. Most were small coal mine operators.

"I tell them I have a small machine," says Nicholas. "I show them how it works and, especially, how it's installed, and I say I can put it in in a few weeks."

Most companies have a coal book in which they list railroad car numbers and the estimated weight of coal each car contains. "They might have a thousand cars going in different directions and they don't get paid until the car gets weighed somewhere along the way," says Nicholas. "Before, they had to 'eyeball' it. To pick out the car number from a long list of cars anywhere in the book. The disk unit of System/32 allows them to get the number right away."

The butcher, the baker, the candlestick maker, it seems, all ordered System/32s. But so did larger customers, among them American Motors.

"The customer wanted to go to distributed data processing," says Jack Eiche, a Milwaukee senior marketing representative who last year installed 22 new accounts. "That is, he wanted to take some of the processing that is done centrally and move it out closer to the user.

"We had been working with DP to develop a solution to the problem in a highly competitive environment. When System/32 came along, it provided the perfect answer."

The 30 System/32s, installed in October at car sales offices and warehouses around the country, respond to parts orders from dealers, relieving a System/370 Model 145 at Milwaukee of a considerable work load and cutting down on line costs.

Why did the customer order the systems in the worst auto sales year since 1962? "The main way you sell cars," says Eiche, "is to give good service. American Motors has a good warranty plan. They wanted a data processing system that could help them implement good service from their dealers."

For the Data Processing Division, the issue never really appeared to be in doubt —but the results were exceptional.

By May, it was apparent that DPD could have a good year. By July, confidence was

growing that in 1975 the division could meet or exceed all of its major measurements. And, while closing with a traditional last-quarter flourish, DPD was already planning how to repeat its success in 1976.

The Field Engineering Division also did its part. A recent customer survey showed that FE service is very satisfactory. Customer satisfaction, it was found, had improved for both hardware and software—and was at one of its highest levels ever. "When considering all aspects of service," a customer wrote, "IBM is number one, which is one of the factors that persuaded us to go to another IBM system—rather than switch vendors."

Many DPD sales reps vividly recalled "taking a bath" in the '70-'71 recession when customers found themselves with more computing power than they had learned how to use and drastically slashed their data processing budgets. They were determined not to let it happen again. They didn't.

"This time, there was better business management—right on through to the individual marketing rep," says A. P. (Gus) Klein, DPD director of account marketing.

"And that's true any way you care to measure it," he adds. "Net sales and installations were very strong, certainly, but to appreciate the real difference you have to look beyond that . . . to the fact that cancellations were the lowest in recent years and accounts-receivable performance was outstanding.

"Considering the odds, I don't think the DP Division has ever turned in a finer all-around job."

Customers had also gained maturity, tempered by the previous recession. And many were already applying their equipment around the clock. "They realized that their business costs were escalating," says Klein, "and one of the few things that could hold costs down and keep them under control was data processing."

In fact, more than a few customers looked to data processing as the key to their survival. "One of my customers is a medium-sized insurance company," says Mitchell Martin, a senior marketing rep in DPD's South Texas branch. "He is seeing a lot of larger firms going into his business. He feels he has to get significantly better productivity to grow and to compete. And the computer is the only way he can make it."

If DPD occasionally made the job look easy—it wasn't. Often, results came only after years of careful planning, of building confidence in IBM people and products, of reaching deep into the company for every conceivable resource.

(Continued on page 31)

Now it's Mr. Ambassador

When President Ford's new Ambassador-at-Large T. Vincent Learson reports for his post as Special Representative for the Law of the Sea Conference and Chief of Delegation at the conference meeting in New York City in March, he will be taking a new look at an old interest.

The sea is in his blood. His father, a ship's captain at 19, used to sail Liberty ships from Boston to Virginia's James River after World War II. Learson owns a prize-winning yacht, and his home on Long Island Sound is filled with sailing pictures and artifacts gathered on numerous snorkeling expeditions.

Since accepting the appointment, Learson has resigned all his corporation board memberships. He had been an IBM Board member since 1961, and continued as such after his retirement as IBM Chairman in 1972. Thus, for the first time since he joined IBM as a sales trainee back in 1935, he will have no direct tie with the company.

The New York gathering of delegates from some 150 nations will engage in eight weeks of negotiation, seeking agreement on what has become an imperative in a world of shrinking resources—wise management of the waters covering two-thirds of the globe.

The conference has met twice before—in Caracas and Geneva—and has made some progress on updating territorial conventions, some of them 200 years old; on navigation, fisheries, continental shelf resources, and marine pollution. Major differences exist over the development of the deep seabed and scientific research.

For Senator Claiborne Pell, who chairs the Senate Foreign Relations Committee's Subcommittee on Oceans and International Environment, this session is the most important United Nations Conference since San Francisco, where the U.N. Charter was drawn up in 1945. In a *New York Times* article, Pell lauded the President's choice of IBM's "able" former chairman as "an encouraging first step" that the Administration is giving it the priority it deserves.

Frank Cary agrees: "Vin Learson's wise counsel and dedicated participation on the IBM Board will be missed by all of us who served with him over the years. But we recognize that his tremendous talents will now be brought to bear on a complex and important emerging issue . . . I know that I speak for all IBMers and Board members in wishing him every success in this new enterprise." ■

GBG GOES GLOBAL

For the General Business Group, a new marketing mission

by Ernie Bauer and Ed Grimm

How the General Business Group lines up. From left: G. B. Beitzel, IBM senior vice president and GBG group executive; Bart M. Stevens, Office Products Division president; Richard C. Warren, General Business Group/International president; and C. B. Rogers, Jr., General Systems Division president. The latter three are IBM vice presidents.

There's a story making the rounds about the new GBG organization. It's that those initials stand for Good, Better, Great. They really don't, but the words do fit the mood in the General Business Group. That mood is distinctly upbeat, and for good reason.

The General Business Group has been evolving for several years, but all the changes and plans came together last year in a series of organizational announcements. Basically, here's what happened:

- The Office Products Division and the General Systems Division took on a worldwide responsibility for their product lines. This includes pricing, product management, and profitability.
- A new division—GBG/International—was established to provide line management for OPD and GSD operations in 17 countries outside the United States.
- A GBG group staff was created to set coordinated goals, establish the strategic plan, and be responsible for worldwide product forecasting, market research, and product line evaluation.

"When Frank Cary put the pieces of GBG together," says G. B. (Spike) Beitzel, IBM senior vice president and GBG group executive, "he said that IBM was doing it to get a worldwide focus on a splendid business opportunity. We have been working hard at that ever since.

"These are the fastest growing parts of the business. Now we've achieved the flexibility and responsiveness needed to make them really take off."

Largely because of its origins, GBG has never fitted snugly into any organizational mold. It began as a loose association of five self-contained divisions or business units: Federal Systems, Information Records, Office Products, The Service Bureau Corporation, and Science Research Associates, Inc. Each had its own business objectives. In all, they employed 38,000 people worldwide in 1972, and their combined business was growing at nearly 7 percent annually.

For two years, the GBG staff consisted only of Beitzel, an administrative assistant, and two secretaries. Each division made and sold its own products and acted as its own profit center.

By January 1974, the lineup had changed. SBC had been sold in the settlement of the Control Data Corporation litigation. FSD went to the DP Marketing Group and was replaced by General Systems. By the end of that year, revenues had doubled, and the Group's employee population stood at just over 50,000.

While both OPD and GSD had their own development, manufacturing, sales, and service organizations in the United States, this was not the case overseas. There was no comparable autonomy for OP and GS operations within the country organizations. Yet the potential in both parts of the world was equally bright.

Would a new kind of organization more effectively tap that potential?

"We thought of making it one business worldwide," said James J. Forese, GBG assistant group executive, finance and planning, "with centralized development, manufacturing, and service. But we decided against that because it really isn't one business, even though the technology may be moving together; and also because this would mean departing from an integrated division concept.

"We also thought of making two businesses worldwide—but then there wouldn't be viable individual companies in all countries because of the different dimensions of local OPD and GSD business. We realized, too, that with three general managers in a country—the country general manager, the OPD general manager, and the GSD general manager—we would be complicating things too much from an organizational point of view."

One key aspect of the decision an-

Ernie Bauer, formerly with Think, *is now with management communications at Corporate Headquarters. Ed Grimm is international editor of* Think.

nounced last July was the formation of a new division. Originally known as the International Operations Division, it is now called General Business Group/International and is headed by IBM Vice President Richard C. Warren. It has taken on line management responsibility for GSD and OPD marketing, service, manufacturing, and operating plan performance in 17 countries outside the United States.

In each country, a general manager, GBG, receives functional guidance from GBG/International. That guidance comes from Paris for the new GBG organizations in Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland, and the United Kingdom; and from Port Chester, N.Y., (White Plains, N.Y., later this year) for the Americas/Far East countries of Australia, Brazil, Canada, Japan, Mexico, and Venezuela.

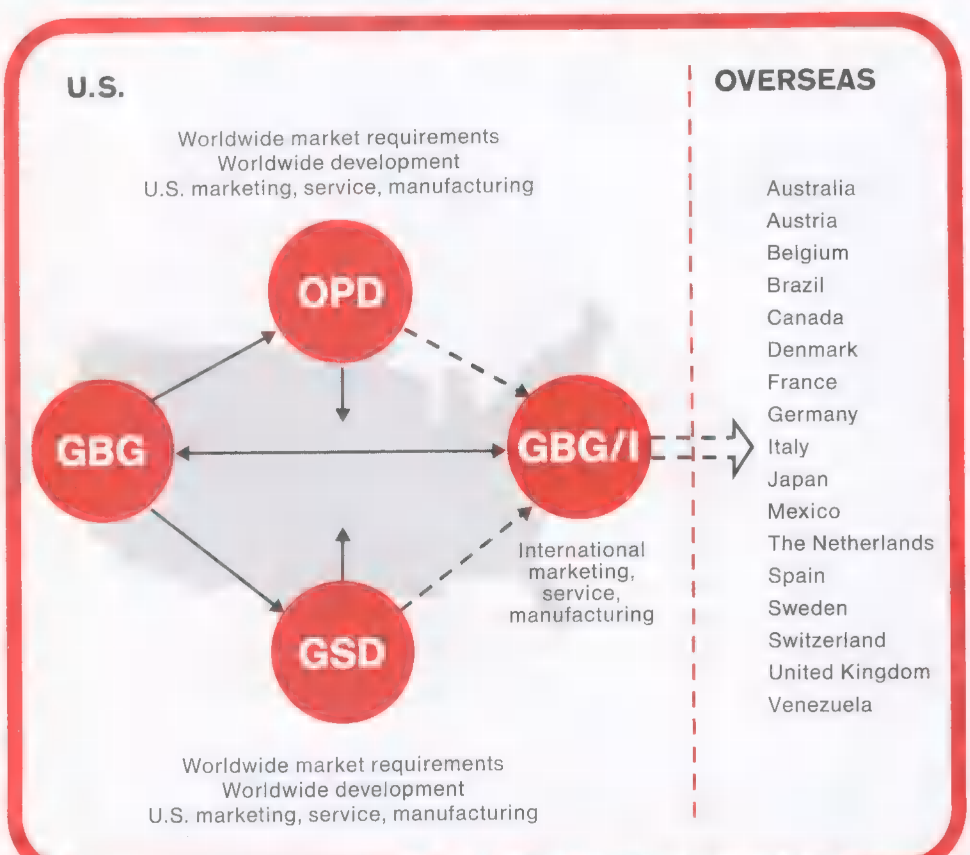
The necessary perspective over both U. S. and international operations is provided by the GBG group staff. "This is the glue that knits it all together," says Beitzel. "It has to be big enough and organized enough to do that—and nothing more. Our organization has to reflect its products by being easy to use, easy to understand, comfortable to work with, and there when needed."

One matter that the new General Business Group is studying is the increasing convergence of OPD and GSD technologies and product lines. Both divisions have traditionally been strong in technology: IBM's first use of monolithic memory was in System/7; and OPD has pioneered single-element technology. Now, the OPD product family includes a typewriter with a memory, while at the same time, the General Systems Division has been steadily shrinking computers to the size of the portable, desk-top computer announced last September.

But even as the technological gap narrows, there remain compelling reasons for keeping the divisions as separate organizations. "For one thing," says Beitzel, "both OPD and GSD are big enough, and in such highly competitive marketplaces, to require dedicated management. For another, there remain basic differences between word processing and data processing as they affect a customer. So a pinpointed approach is still called for. It's the best way we know of to keep our development and manufacturing on the leading edge of the business."

The people in GBG see themselves in two races: One is to outdistance a competition that is growing rapidly and gathering expertise just as rapidly. The other is to manage their organization so that it stays closely attuned to its growing, changing business.

There is a lot of talk at GBG these days about being "lean" and "potential-driven" and "customer-oriented." And it is a lot more than just talk. ■



Product line

General Business Group

Office Products Division

Typewriters	Model D Executive and Standard Selectric Selectric II Correcting Selectric
Magnetic Media	Magnetic Tape/Selectric Typewriter Magnetic Card/Selectric Typewriter Communicating Mag Card Selectric Typewriter Mag Card Executive Typewriter Mag Card II Typewriter Memory Typewriter Magnetic Card/A Typewriter
Graphics Products	Selectric Composer Magnetic Tape Selectric Composer Electronic Selectric Composer
Input Processing Equipment (IPE)	Belt-type Input and Transcribing Units 6:5 Cartridge System
Copier	Copier I and Copier II
Input/Output Equipment	Selectric II Typewriter (basic terminal unit) 735 I/O device 745 I/O device

General Systems Division

IBM 5100	portable computer
IBM 3741	Models 1 and 2 (data stations)
IBM 3741	Models 3 and 4 (programmable work stations)
System/7	(21 stand-alone models)
System/32	(15 sub-models)
System/3	(6 models)
IBM 1130	
IBM 1800	
System/360 Model 20	

Faster Smaller Cheaper

There's nothing quite like it. Nothing that has come so far, so fast. Nothing that has become so much a part of today's everyday work-a-day world. It's the electronic computer. And to celebrate this first quarter-century of technological innovation, IBM is presenting an exhibit at 590 Madison Avenue on "The Evolution of IBM Computers." See it next time you're in New York.

The evolution is described in this special section. Prepared by the editors and staff of *Think* as a brochure for schools and institutions, it is reproduced here for readers of *Think*.

Art direction: Will Hopkins
Text by Richard Bode

It was to have been the nuclear age.
It became the computer age.

Fastest 25 Years

In the past quarter-century, the computer has moved from the margins of our existence into the center of our lives.

Few technologies have come so far so fast.

By 1951, the computer had been developed and introduced into commerce. But even those closest to it were unprepared for what would follow. The computer's spectacular growth—in numbers, in power and capability, in the variety of things it does—came as one of the great surprises of modern times.

What may not be surprising, but can be heartening, is that the success of the computer appears to be the result of many people trying to solve many problems in many fields—as a natural consequence of getting on with the business of life in general.

The success of the computer is based upon its ability to store and process vast quantities of information. It can add to, update, and retrieve that information, and transmit it across continents via communication satellites and telephone lines. It can calculate, make comparisons, simulate events, and monitor ongoing industrial and scientific operations. It can do all those things reliably with great ease and speed.

All these functions flow from the basic faculty of the computer to manipulate and store data in the form of numerical codes. The computer has evolved naturally through the centuries from early counting devices like the abacus. But today, instead of manipulating beads on a wire, we rely on electronic impulses to accomplish the same goals.

And most important, as a result of technological innovations in these last 25 years, the costs of computing have come down from $1.26 for 100,000 multiplications in 1952 to one cent today. It has become feasible to use computers for applications today that would have been uneconomic only a few years ago.

Like the telephone, television, the automobile, and the airplane, the computer has transformed our world. And like so many of those other inventions, it is built upon know-how that emerged quite rapidly, especially (in the case of the computer) after the end of World War II. In quick succession the computer went from electromechanical counters to vacuum tubes to magnetic storage and memory to microscopic solid-state circuits.

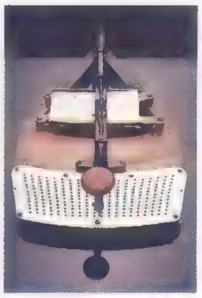
Conceptually, the computer came into its own when two groups of scientists, engineers, and mathematicians—one working at the University of Pennsylvania and the other at IBM—struck upon the idea that the machine could store its own operating instructions. Its subsequent development flowed from the practical application of innumerable new technologies in both hardware and software. Over the past quarter-century, IBM introduced hundreds of new products, and many of these represented advances in the state of the computer art.

The following pages tell the story of IBM's entry into data processing, and the computer revolution that followed.

1890–1946

Wheels and levers

The beginning of data processing

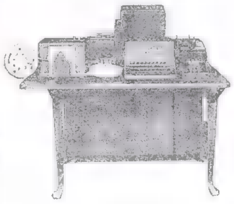


An original Hollerith keypunch. This mechanical device, along with a tabulator and card sorter, enabled the U.S. Government to count the 1890 census twice as fast as the 1880 census even though the population had grown by 25 percent. The Hollerith concept, while improved upon through the years, remained the basis of the information processing industry through World War II.

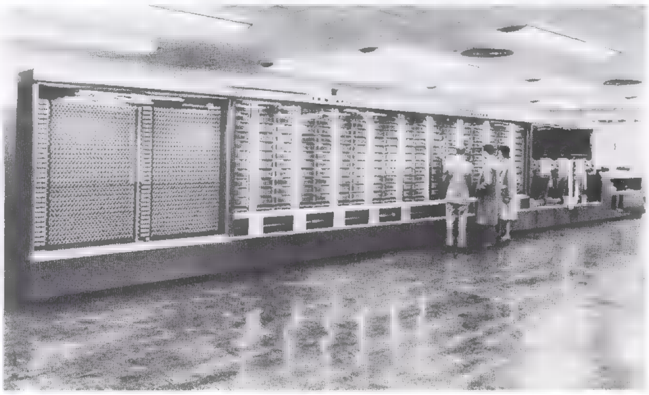
'This apparatus works unerringly as the mills of the gods, but beats them hollow as to speed.' —Electrical Engineer November 11, 1891

In the 1880s, the U.S. Census Bureau faced a crisis. It was clear that by the time it could count the 1890 census the data would be obsolete. So the Bureau held a contest to see if it could find a faster way to tabulate the results. Dr. Herman Hollerith, a young engineer in the Census Bureau, won hands down. He invented an electromechanical machine activated by punched cards. The holes in the cards represented vital statistics. Hollerith said the idea occurred to him when he saw a railroad conductor use a ticket punch. In 1896, Hollerith founded the Tabulating Machine Company, one of three firms which later became International Business Machines Corporation.

A mainstay of the business, the IBM 080 card sorter was a familiar object to four decades of office workers. It was still being manufactured in the 1950s.



In 1941, this IBM 040 unit converted telegraph paper tape directly into punched cards. It was the first machine to do so. With the 040, the U.S. Air Corps obtained summary totals of equipment in inventory at its depots daily instead of annually.



In 1944, Harvard's Dr. Howard Aiken and IBM built the Mark I, the largest electro-mechanical calculator ever built. It had 3,300 relays and weighed 5 tons. It could multiply two 23-digit numbers in six seconds.

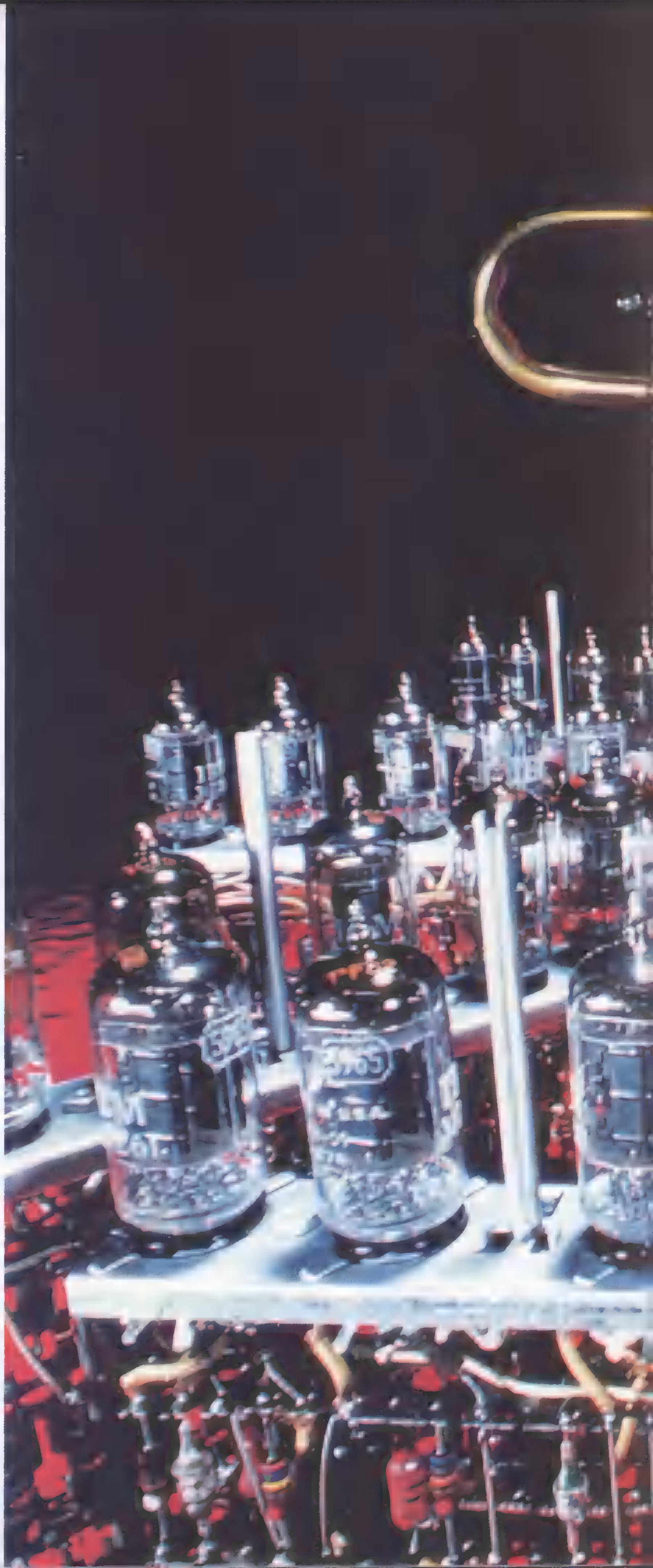
→ The Hollerith tabulator relied on electromagnetically operated counters and relays. From that central invention emerged progressively faster tabulating and companion machines. Introduced in 1925, the IBM 080 card sorter processed 400 punched cards per minute. The IBM 031 keypunch, introduced in 1933, was the first machine to permit punching of letters as well as numbers into cards. The IBM 405 tabulator, introduced in 1934, could add or subtract 150 punched cards per minute.

1946
The vacuum tube

With electronics, thousands of times faster

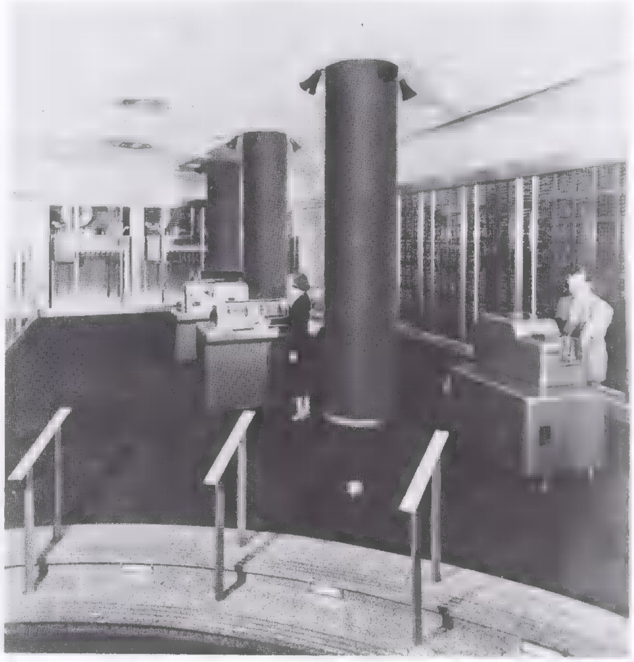
Electromechanical machines were too pedestrian for the swift-paced postwar world. Users wanted speed, and the vacuum tube responded to their demand. Vacuum tubes, flipped on and off like switches, could count thousands of times faster than moving mechanical parts. But the story doesn't lie in vacuum tubes alone. It lies in the creation of computer systems that incorporated not only vacuum tubes, but also other advancing technologies. Between 1946 and 1952, a series of electronic calculators and computers emerged in rapid succession: ENIAC at the University of Pennsylvania, the IBM Selective Sequence Electronic Calculator, the IAS computer at Princeton, UNIVAC for the Census Bureau, and the IBM 701—to name a few.

The electronic vacuum tube was thousands of times faster than the electrical relay. In 1946, vacuum tube computers could multiply two 10-digit numbers in 1/40 of a second; by 1953, in 1/2000 of a second.



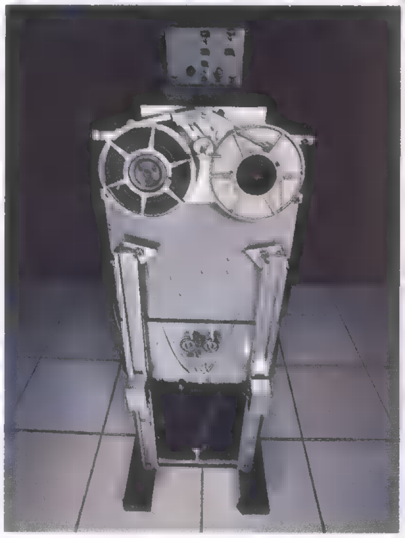
The IBM 604 was the first electronic calculator to supplant electromechanical office equipment. It was also the first electronic machine that could be easily repaired. Without tools, service engineers could remove one tube (shown at top) and plug in another. The array of tubes (below) were used in a later computer.


IBM
5965

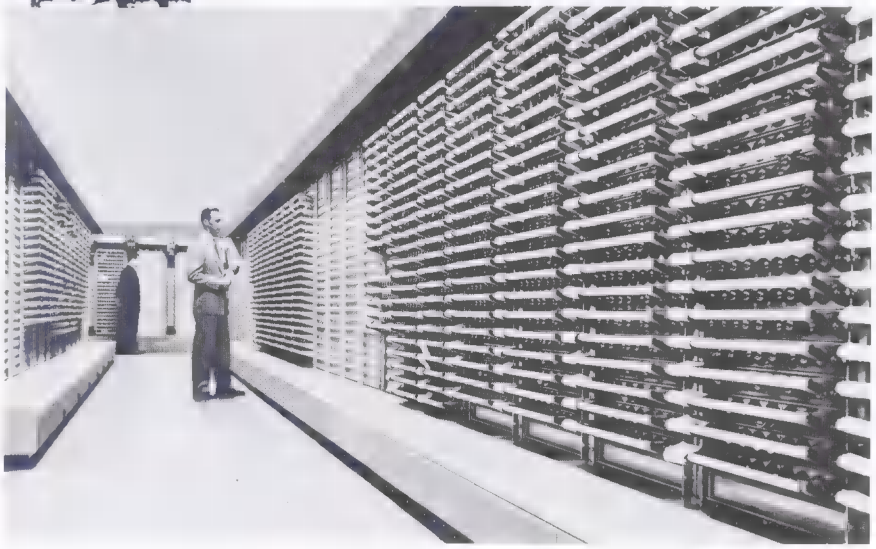


←
The IBM 701 could add a typewritten column of 10-digit numbers as tall as the Statue of Liberty in about one second. In one hour it could solve a problem in aircraft wing design that might have taken an engineer seven years with a desk calculator. Announced in 1952, the 701 was a portent of the larger, faster machines yet to come.

↑
The IBM Selective Sequence Electronic Calculator, completed in 1947, contained both vacuum tubes and relays. It could multiply 6,000 times faster than the Mark I. It was the first IBM stored program machine, and it could select its own calculating sequence by modifying its own stored instructions—thus, its name.



↑
The vacuum tape column, invented by IBM in 1949, controlled the reeling and unreeling of tape and kept it from snapping.



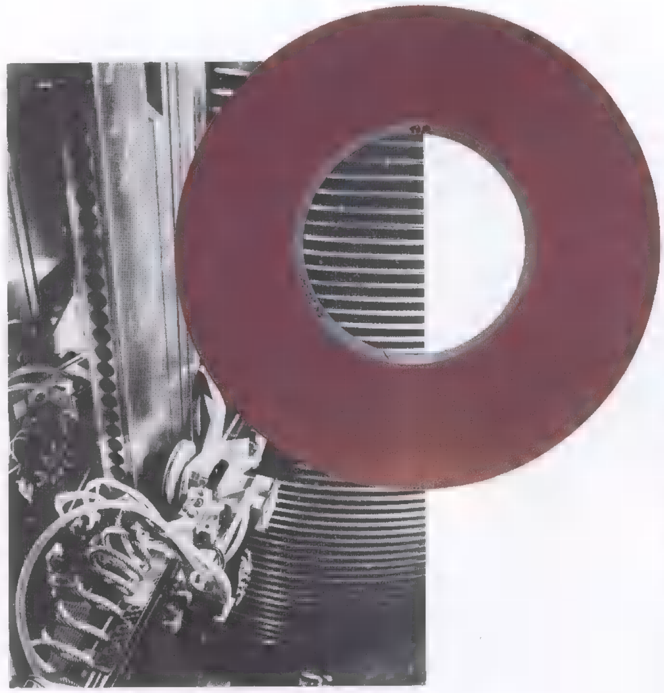
→
IBM's Naval Ordnance Research Calculator was the most powerful computer of its day back in 1954. It had 9,000 vacuum tubes.

1953

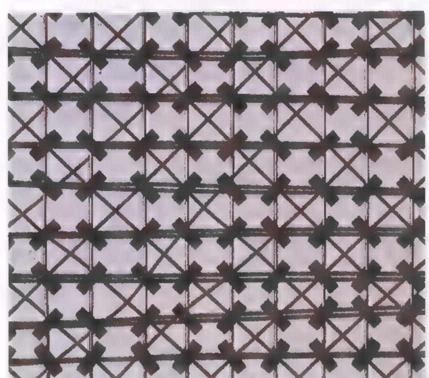
Magnetic storage

Better ways to find information fast

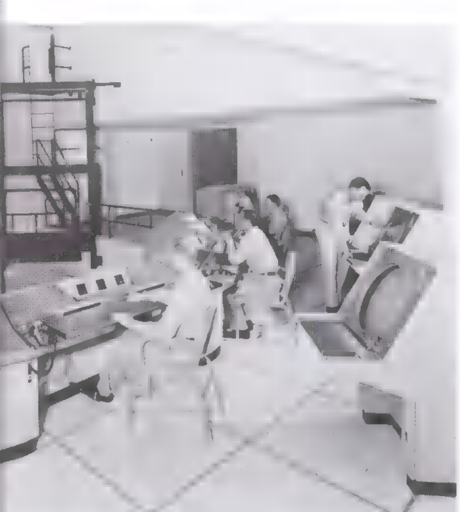
The vacuum tube vastly increased the computer's calculating speed. But it did little to improve the efficiency of two other critical aspects of the computer's configuration: storage and memory. The early vacuum tube computers stored data on punched cards or tape and drums and relied on cathode ray tubes or drums for active memory. Punched cards were slow and not rewritable. Tape could be inefficient because of the time taken in reeling and unreeling. Cathode ray tubes were expensive and unreliable. The urgent demand for faster and cheaper storage and memory devices stimulated research and development in magnetics — magnetic disks and drums for storage, magnetic cores for memory, and better materials for better magnetic tapes.



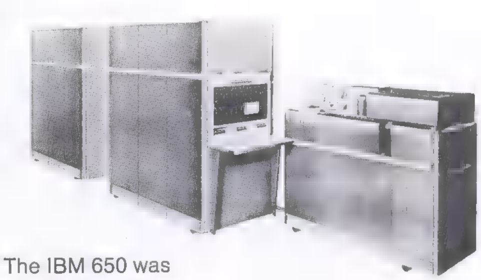
← When IBM introduced its 305 RAMAC (for random access) in 1956, data processing leapfrogged into the future. Magnetically coated aluminum disks (such as miniature replica at left) stored volumes of data on concentric tracks. In a fraction of a second, a read/write mechanism found the right magnetic spot and retrieved data from any point on the disk. The RAMAC's 50 spinning disks contained five million characters of information.



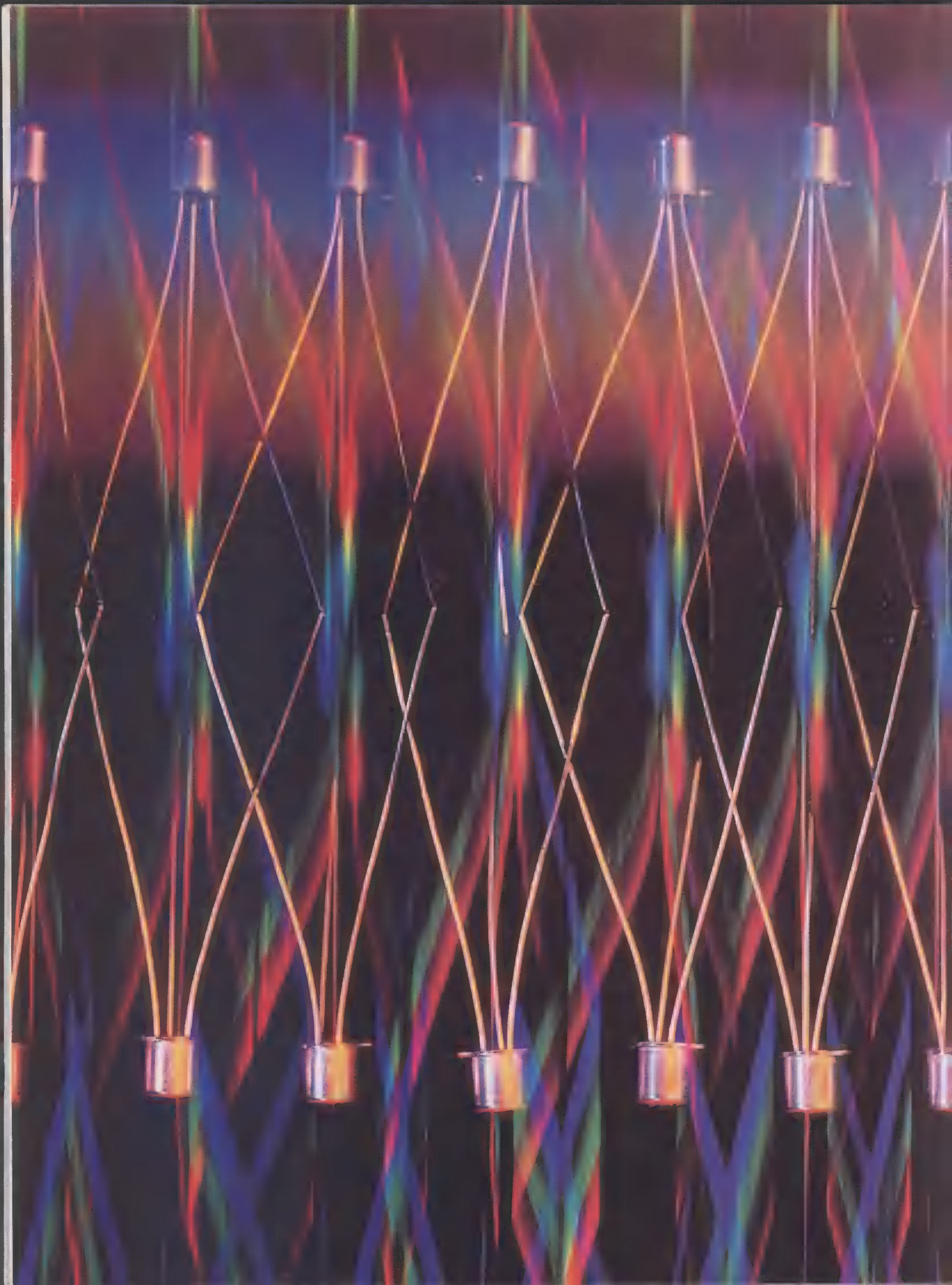
↑ Current-carrying wires that pass through iron oxide cores magnetize them clockwise or counterclockwise. Cores switched from one magnetic state to the other in millionths of a second. One magnetic direction represents a zero, the other, a one in the computer's binary code. Inventors outside IBM originally developed the donut-shaped cores for memory, and IBM perfected the method for making them. The company adapted pill-making machinery to produce them by the millions.

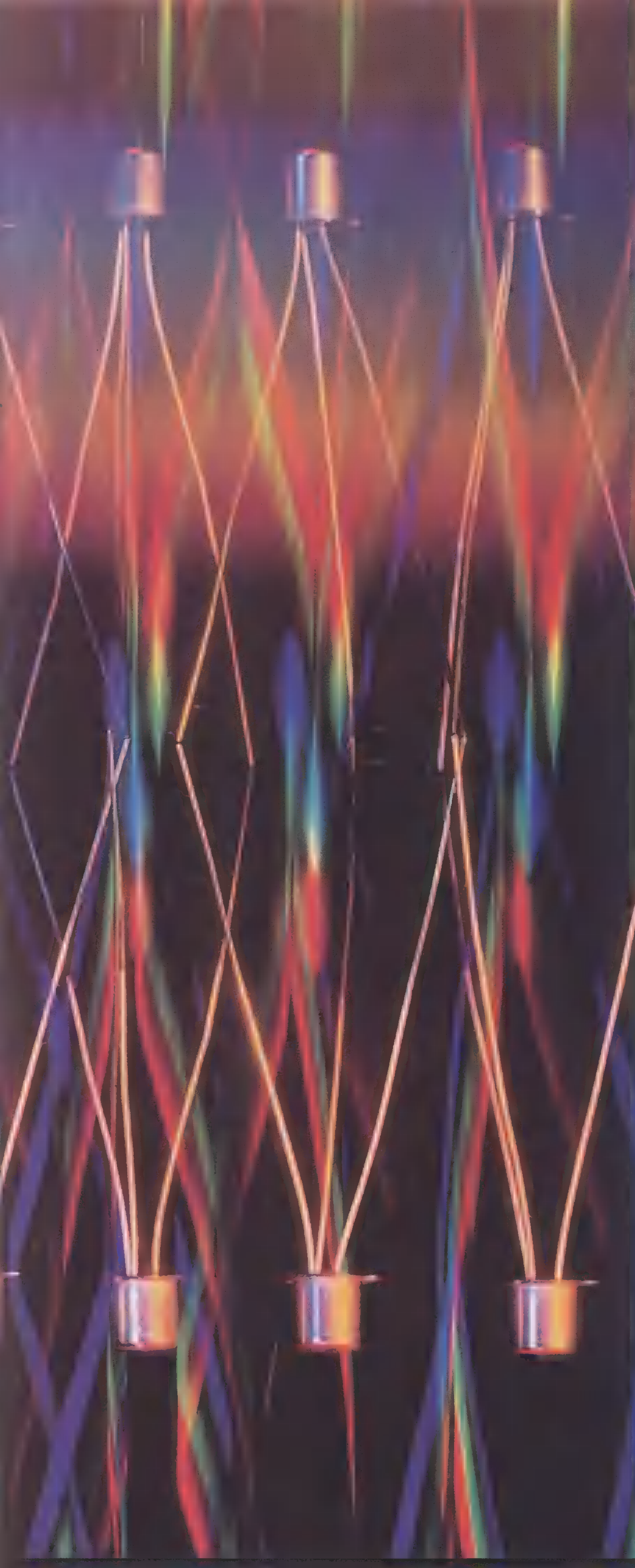


← Vacuum tubes and core memories were first combined in the mammoth computer built by IBM under the direction of M.I.T. for the U.S. early air-defense warning system called SAGE. The 113-ton computer, containing 58,000 tubes, processed data transmitted from a radar network in real-time. That is, the data was processed as rapidly as it was received.



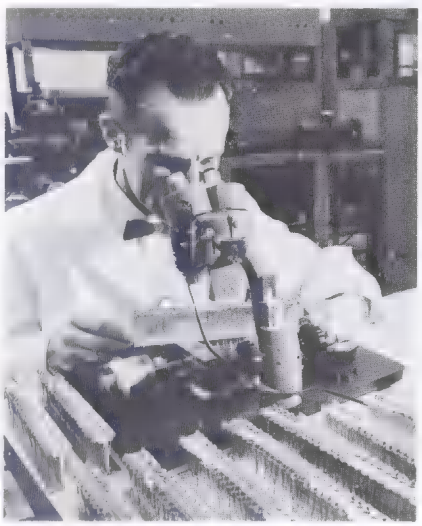
The IBM 650 was a widely used general-purpose computer for business, industry, and universities. When introduced, it processed data on punched cards. Later users could add magnetic tapes and disks. The 650 had a magnetic drum memory.





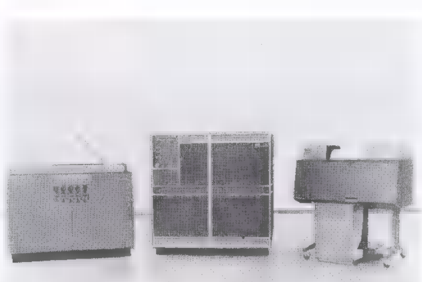
1959
Transistors
Smaller, faster, more reliable

The transistor was invented at Bell Laboratories in 1948. But it's often a long road from invention to application. IBM and the semiconductor industry invested nearly a decade in research to perfect a mass production and testing process and to incorporate the solid-state technology—which the transistor represented—into the computer. The transistor was only 1/200 the size of the bulky vacuum tube. It was smaller, faster, and could be packaged tightly—an electrical impulse had less distance to travel. And because it was composed of a solid substance, it was far more rugged and reliable. In operation, it generated much less heat than a vacuum tube. In the late 1950s, more sophisticated computers arrived—ones that employed transistors for arithmetic, ferrite cores for memory, and magnetic disks or tapes for storage. Now the computer could multiply two 10-digit numbers in 1/100,000 of a second.



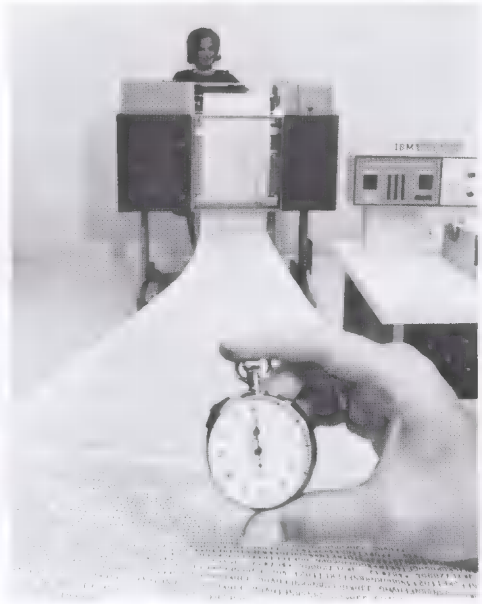
IBM built the industry's first fully automatic transistor production line at its Poughkeepsie plant in 1959. Holding to tolerances as close as 1/2000 of an inch, the line produced and tested 1,800 transistors per hour.

Transistors and printed circuits were combined on cards. The cards were plugged into large frames, or gates, like this one from the IBM 7070 computer.



Introduced in 1959, IBM delivered more than 10,000 of these transistorized Model 1401 computers, many to small and medium-sized users—making it by far the most popular computer up to that time.

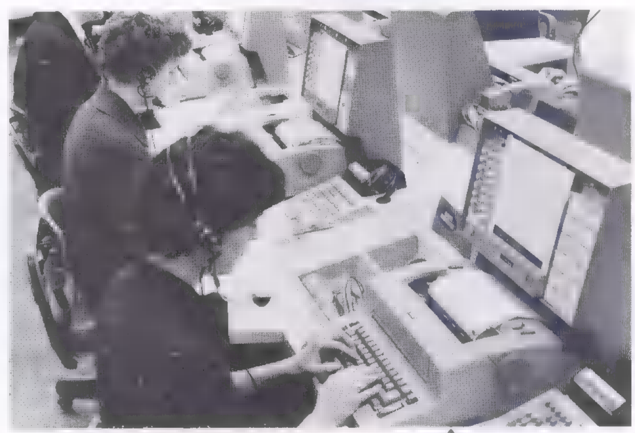
STRETCH, built by IBM in 1960, was the most powerful computer of its day. Its 150,000 transistors could execute 100 billion instructions per day. It could cope with more than one instruction at a time and prepare itself for future work.



As computing speeds increased, so did printing speeds. The "chain" printer produced 600 lines per minute in 1959, a fourfold increase over earlier IBM printing methods.

In 1963, the "train" printer boosted printing speeds to 1,100 lines per minute. Rather than riding on a chain, typefaces now rode on a steel track.

The disk pack. IBM introduced storage units with such removable disks in 1961. Each disk pack contained 2 million characters of data, and the user could switch packs with ease. At about the same time, one IBM tape reel could store 17 million characters of information. A tape unit could read and store the equivalent of 1,100 punched cards per second.



The transistor opened the computer to applications that demanded great speed and huge capacity. SABRE, the airline reservation system, was the first large commercial computer network. It significantly reduced the time needed to make reservations. Developed by IBM for American Airlines, it went into operation in 1962. It operated on-line in real-time. That is, changes in schedules and reservations were recorded as they occurred.

The Apollo moonshot was simulated thousands of times on an IBM System/360 Model 75 before actual flight. This solid-state electronic computer provided the speed necessary to prove trajectory calculations and to train the flight crew.

1964

System/360

First 'family' of computers

The early transistorized computers advanced the state of computing technology. But they had one important drawback: They weren't compatible. Users often had difficulty switching from one type of computer to another without rewriting their programs. Peripheral devices designed for one computer often wouldn't work with another. What users really needed was a family of compatible computers in which peripherals and programs could be interchanged. Realizing this, IBM—at considerable risk—replaced its computer product line. In 1964, the company came out with System/360—the first family of compatible computers, ranging from small to large.

On the day of introduction, there were five central processing units. The smallest processor could perform 33,000 additions per second; the largest, 2,500,000 per second.

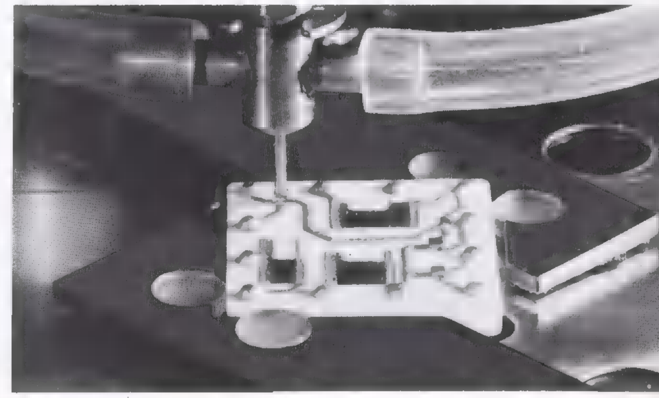
Variations among processors gave users 19 combina-

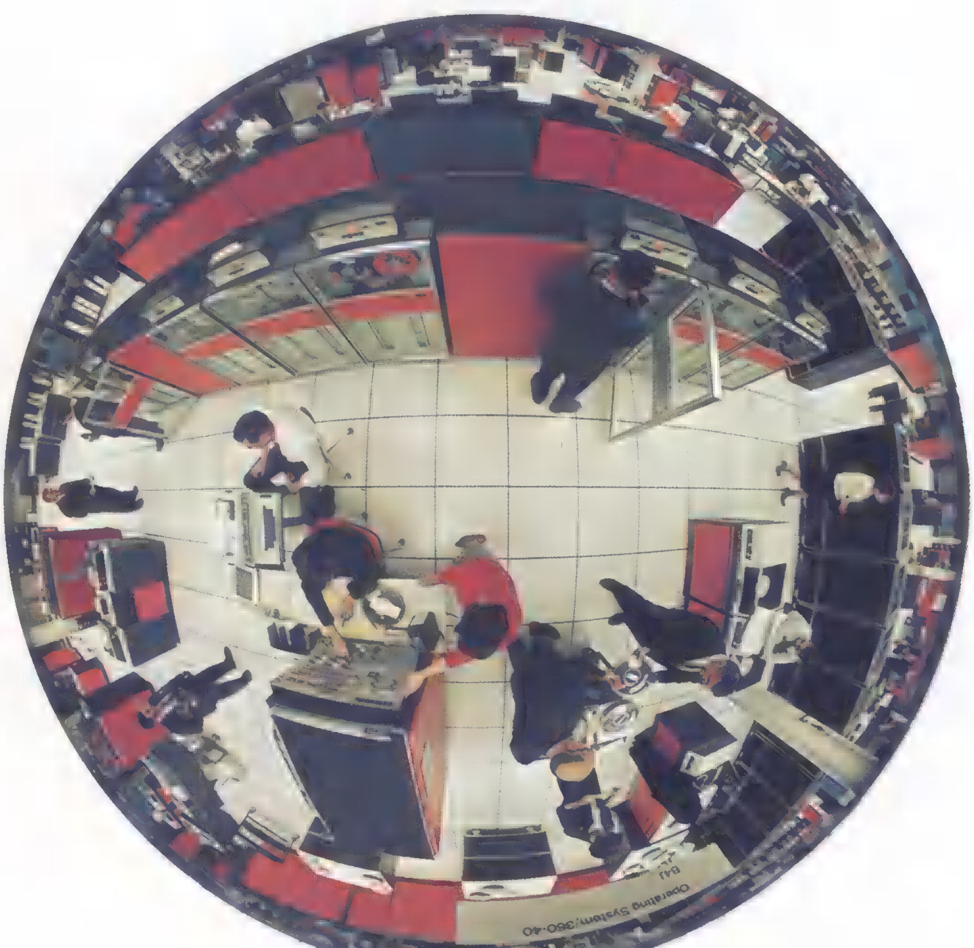
(Continued on page 14)

tions of graduated calculating speeds and memory capacity.

As users added applications, they could add or replace processors without rewriting programs. With certain limitations, instructions for one model ran on the others.

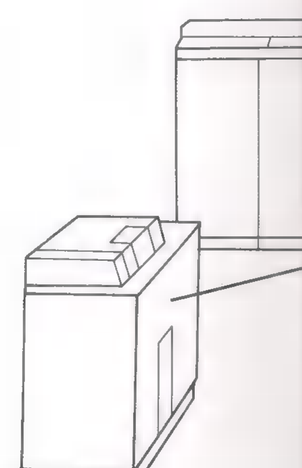
All five processors worked with most of the 44 attachments. Users could select the combination of disk or tape units, printers, communication devices, and other attachments that best served their needs.





How the computer

A computer may be a single machine, but is often a configuration of machines designed and programmed to work together, as a system. When we think of a computer system, we should think of the conversion of data into electronic signals sent back and forth among the particular machines that compose the system. The machines are connected by cables and often linked with telephone lines to distant locations.



←
With System/360 came Solid Logic Technology (SLT). IBM developed techniques for placing tiny circuits on half-inch ceramic modules. Some System/360 circuits could switch on and off in 6-billionths of a second, twice the speed of previous IBM circuits. One problem: positioning transistors 28/1000-inch square on the module. Vacuum needles did the job. SLT was highly reliable. Statistically, an SLT module ran 33 million hours on average without failure.

←
The Model 91 was IBM's most powerful computer when delivered in 1967. Its speed ranged up to 16 million additions a second.

works

Input

We can enter data directly into the computer with the keyboard of a typewriter terminal similar to those used by bank tellers and airline reservation clerks. Or we may enter data through a card reader that converts holes in punched cards into electrical impulses. Did you ever notice those oddly shaped numerals at the bottom of checks? They're printed in magnetic ink, and another kind of input device can sense those shapes and convert them into electronic signals.

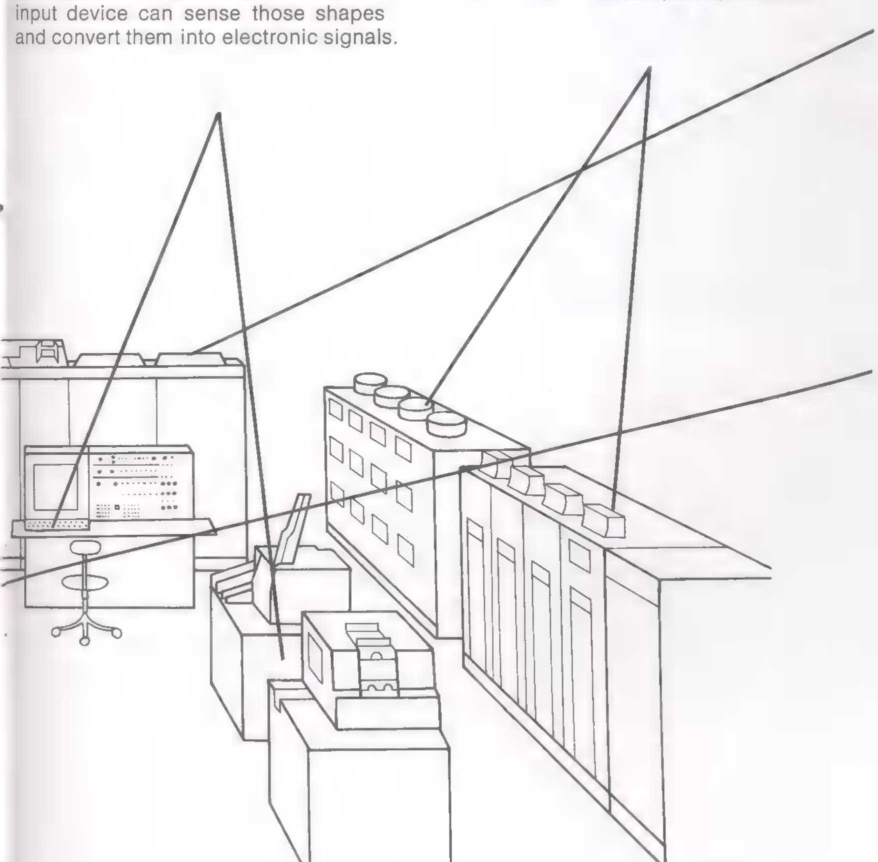
Storage

Once we enter data, we need a place to store it so that it's readily available when we want to use it. The punched card itself is a permanent storage device. It holds information that can be used over and over again. But today we store most data magnetically on disk or tape. We can pack data quite densely in this manner—as many as several million "bits" of data per square inch.

Central Processing

Suppose a stack of magnetic disks contains a complete company payroll. To make out the payroll checks, each in the proper amount with the proper deductions, we must transfer data from the disks to the central processing unit (CPU), which consists of memory and arithmetic/logic circuits.

A device called a channel automatically moves payroll data and related application programs from disk storage to active memory. Once the data is in memory, the arithmetic/logic section takes over and performs the necessary steps in proper sequence to make out the paychecks. Once the payroll transactions are completed, the data is sent back from memory to disk storage. There is a constant transfer of data between memory and storage.



Output

High-speed printers—activated by electronic impulses— can print checks, invoices, tables, even report cards at up to 2,000 lines per minute on impact printers.

A student sitting at a remote terminal can "converse" with the computer; that is, query the computer and obtain a typewritten answer in seconds—provided, of course, the proper information and instructions were entered in the first place. We can also obtain output on video screens similar to television sets.

↑
Small and rugged, this onboard 59-pound computer helped guide Gemini spaceflights through rendezvous, docking, and splashdown. For guidance and navigation, IBM developed another family of computers, called 4 Pi. In many applications, magnetic drums were used for storage because of durability, size, and quicker access time.

←
IBM programmers wrote programs that contained 6 million lines of code for the ground-based computers that controlled the Apollo space flights.

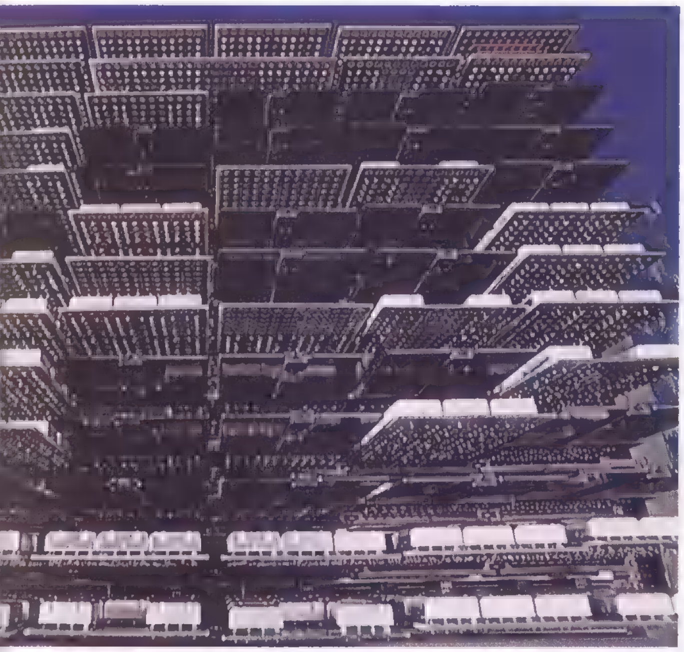
→
Solid Logic Technology simplified production and maintenance. Laminated cards holding half-inch modules were plugged into foot-long circuit boards. Boards, in turn, were mounted on "gates" on the computer framework.

The evolution of pr

When a computer makes out a payroll or calculates the orbit of a satellite, it appears to have accomplished something remarkably complex. Actually, it has merely executed in sequence a large number of simple steps as directed by a set of instructions called a program, which is written by a person called a programmer. The computer has no mind of its own. It only does what the programmer tells it to do.

In the early days, we had to rearrange the wiring in the computer every time we wanted it to perform a different task. Subsequently, computers were designed so that operating instructions could be stored within the computer itself.

Today's computer handles many operations concurrently. Consequently, it must be programmed so that it can calculate, transfer data, record input, and generate output—all at the same time. For that reason, control programs—which coordinate the work as it flows through the computer—grow in importance as computing speeds rise. They have been called the "glue" that holds the system together. When IBM introduced its System/360, the operating software was



→ Timely data became as important as capacity and speed. With the IBM 2314 disk storage system, any record on file could be updated in a fraction of a second.

ramming

every bit as critical as the Solid Logic Technology.

01110101110001001111010011101

To understand programming, it helps to understand how computers count. When people process data, they use 10 digits and 26 letters. But when computers process data, they use only two digits—a zero and a one. Why only two? Mainly because an electrical impulse exists or does not exist. Either a switch is on or it's off.

Think of the computer's vacuum tubes or transistors in terms of light bulbs. If the light is on, that represents a one. If the light is off, that represents a zero. Thus, in one binary code, the capital letter *J* is represented by a string of eight light bulbs in the following order: 11010001. All numbers, letters, and symbols in common usage can be represented in this way.

These zeroes and ones constitute machine language. During the early 1950s, programmers had to communicate with the computer in machine language—that is, in terms of zeroes and ones. Thus, if they wanted the computer to calculate how far a train would travel at 60 miles per hour in 3 hours, the instructions might look like this:

```
1001 0000 1110 1100 1101 0000 0000 1100
0000 0101 1100 0000
0101 0000 1101 0000 1100 0000 0101 0110
0100 0001 1111 0000 1100 0000 0101 0010
0101 0000 1111 1101 0000 0000 0000 1000
0001 1000 1101 1111
0100 0101 0001 0000 1100 0000 0001 0110
1000 1111
0000 0000 0000 0001 0000 0000
0000 1010 0001 0011
0101 1000 0010 0000 1100 0000 1001 1010
0101 1000 [illegible] [illegible] 1100 [illegible] [illegible] 1110
```

By the mid-1950s, symbolic Speedcoding reduced the programmer's task to more workable dimensions. With Speedcoding, a complex set of instructions might look like this:

```
0100 RFTPJ 0200 0201 ____ ____ ____
0101 MPY   0200 0201 0202 ____ ____
0102 PRINT 0202 0202 0999 TRMN 0104
0103 NOOP  0000 0000 0000 STOP 0100
0104 NOOP  0000 0000 0000 STCH  0
```

Gradually, programmers devised languages that more closely resembled English statements. A translation program, simultaneously fed into the computer, called a compiler, converted the statement written in a programming language into machine language.

FORTRAN (an acronym for Formula Translation) was one of the first high-level programming languages. Developed largely by IBM, it was based on algebra plus a few rules of grammar.

```
RATE=60
TIME=3
DISTNC=RATE*TIME
WRITE (6, 1) (DISTNC)
1 FORMAT (1X, 'DISTANCE=', F5.0)
```

FORTRAN was developed mainly to solve scientific problems. Subsequently, a group of languages for business applications—COBOL, RPG, BASIC, and others—appeared. Another significant advance occurred with the development of APL (A Programming Language), which can be learned in a few days.

```
        3 × 60
180
```

Today researchers are busy trying to perfect techniques that will allow laymen to instruct the computer in their own words.

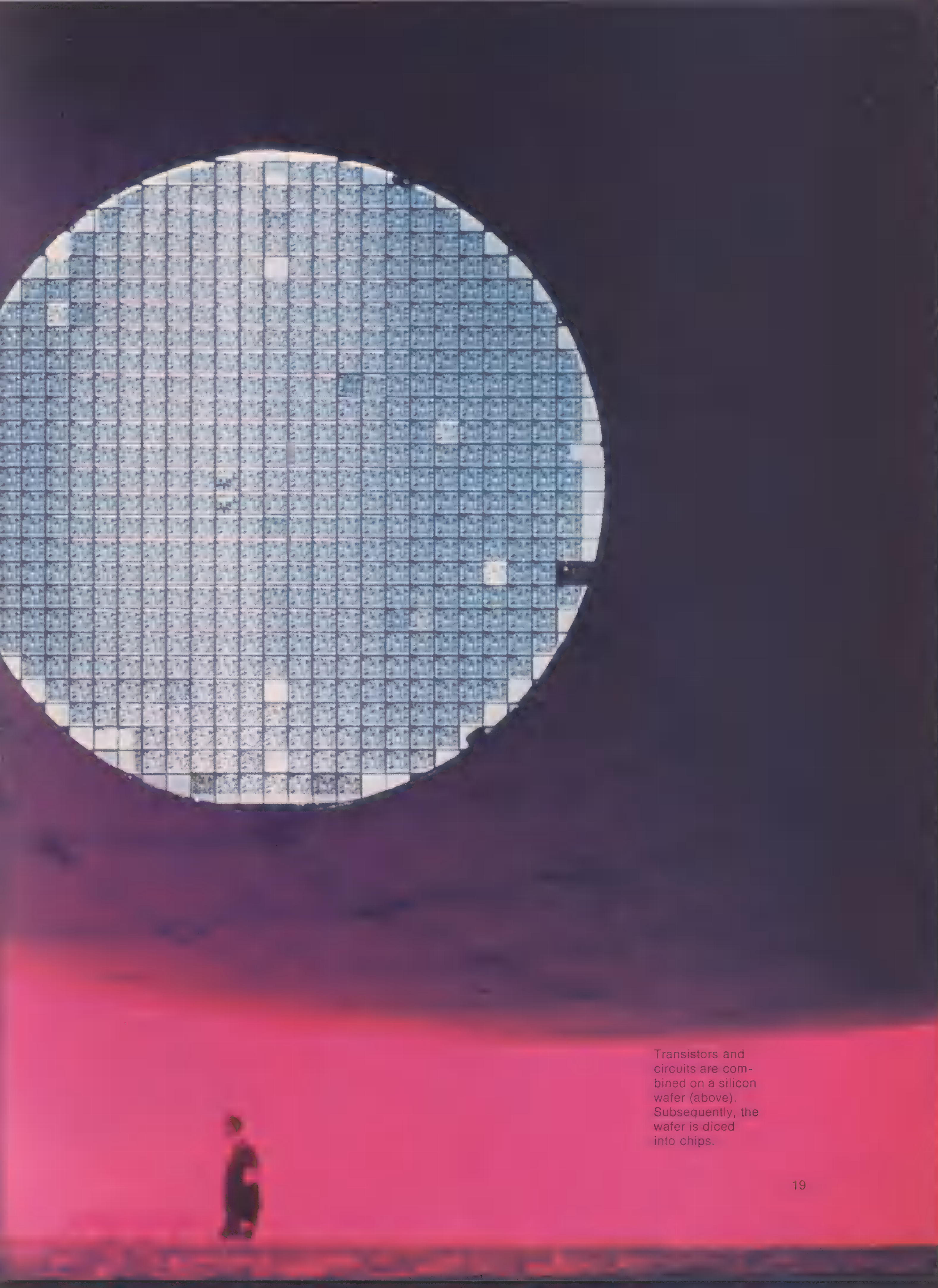
1970

System/370

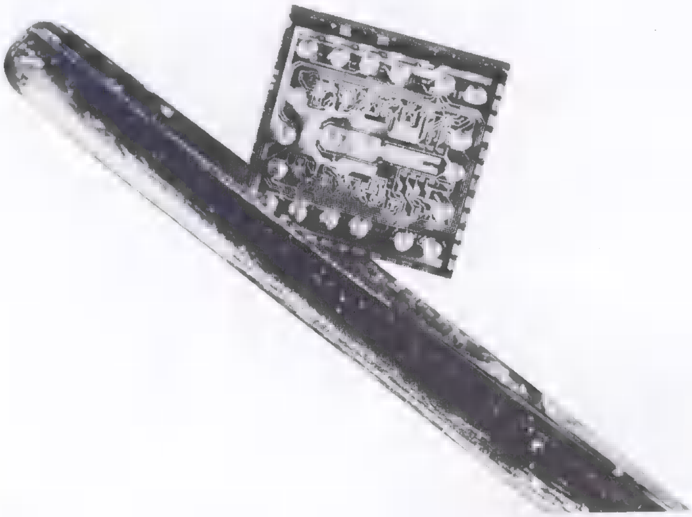
Technology makes the difference

From System/360 to System/370—that denotes not only a long technological step, but also a logical one. Like its predecessor, System/370 embraces a family of compatible computers. But the technology that makes it tick is more advanced. The most obvious difference lies in memory. In System/360, the central processing unit consists of magnetic cores for memory and Solid Logic Technology for calculating. In most System/370 models, both memory and arithmetic/logic consist of integrated circuits. But that long step forward doesn't depend upon transistors alone. It rests also upon what the industry calls 'monolithics' and Large Scale Integration—that is, the compression of transistors and circuits onto tiny memory chips. This is the new world of micro-miniaturization. With monolithic circuits come other advances in storage and terminals. Most System/370 models, for example, have 'Virtual Storage' capability that magnifies the capacity of main memory many times, and enables users to work economically with millions of characters of information.

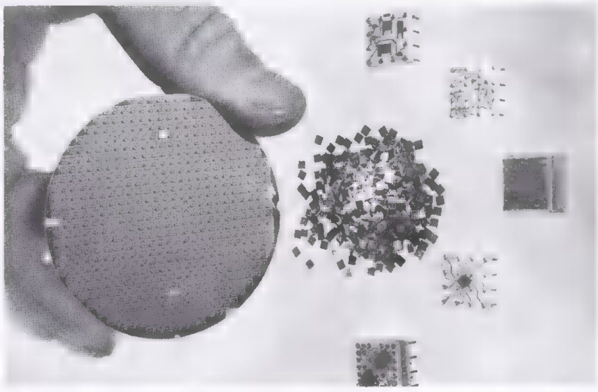
Before Virtual Storage, all instructions and information pertinent to a particular application had to be moved from auxiliary storage to main memory. With Virtual Storage, however, the computer can process an application with only a relatively small portion of the pertinent information and instructions in main memory. Data moves from storage to main memory only as it is needed. As a result, there is more room in main memory to process other applications at the same time.



Transistors and circuits are combined on a silicon wafer (above). Subsequently, the wafer is diced into chips.

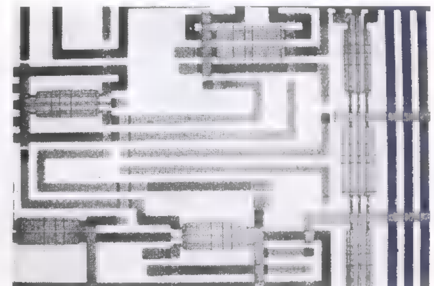


↑
In the eye of a needle, a chip magnified approximately 500 times, contains 25 circuits for performing arithmetic. With monolithic technology, System/370 computers can make millions of calculations a second.
In 1972, System/370 main memory used four silicon memory chips, two mounted on each module layer, contained more than 4,000 bits of data—the same as 4,000 cores. This monolithic memory is four times faster and more reliable than core memories.

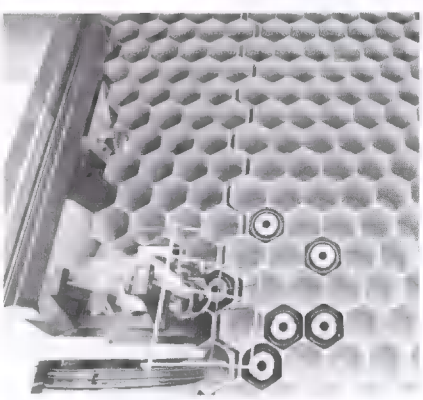


↑
Just as IBM developed advanced manufacturing methods for magnetic core memories and early transistor computers, so it also was one of the pioneers in developing production methods for monolithic circuitry. The technique begins by slicing a 2¼-inch diameter wafer from a silicon ingot. Then thousands of tiny electronic devices are formed on the wafer by repeating various photographic, etching, and chemical processes. Next, the wafer is diced into chips approximately 1/10-inch square. Finally, chips are mounted on single- or double-stacked ceramic modules and encapsulated in a protective aluminum cover for placement in logic/arithmetic or memory.
Today, the engineer designs the circuitry with the aid of a computerized cathode ray tube display. The computer checks the engineer's design and drives the photographic system.

←
The virtue of monolithic circuitry is clearly evident in the IBM 5100, introduced in 1975. It weighs only 50 pounds. Portable, it can be plugged into a wall socket.

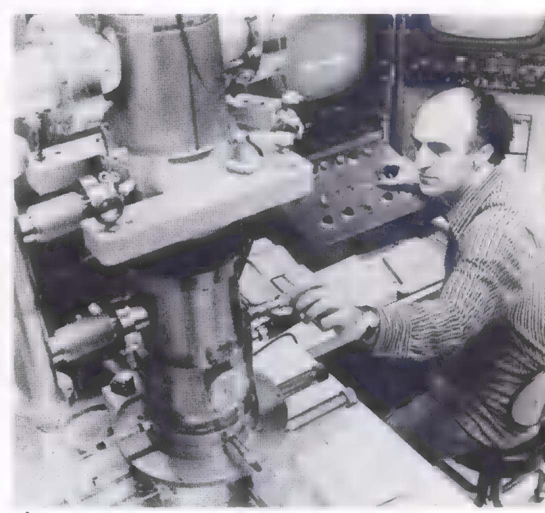


↑
How fast is fast? IBM scientists have fabricated an experimental electronic device that can be switched on and off in 10 picoseconds . . . far faster than current computer devices. The switch is called a Josephson tunneling junction.

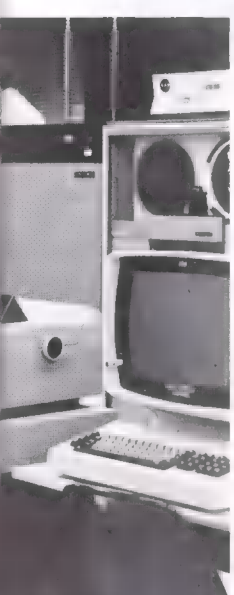


←
The IBM 3850 Mass Storage System—a beehive of electronic activity. It contains up to 472 billion characters of information. Cartridges in each honeycomb cell contain magnetic tape. On signal, data on tape is transferred to disks, then to computer memory. Introduced in 1975, it gives quick and inexpensive access to vast files of data.

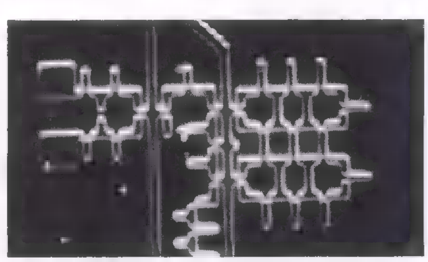
↑
The laser, a unique source of pure and coherent light, and electrophotographic printing are combined in the IBM 3800 Printing Subsystem, six times faster than the company's fastest system to date. The printer can print 13,000 lines of computer output per minute.



↑
How small is small? Current fabrication methods rely on ultaviolet light to draw the circuit lines. With the process, one can print the entire Bible—all 1,250 pages of the Old and New Testaments—on a wafer $1\frac{1}{2}$ inches square. IBM scientists are now performing a technique to replace light with electron beams—an even finer instrument for drawing circuit lines. With electron beams, one can print information enough to fill a book on a wafer $\frac{1}{8}$-inch square.



←
System/370 Model 145—the first computer with monolithic technology for a full-sized main memory. Up to 262 memory cards can hold 262,000 characters of data. Like other System/370 models, it can act upon programs written for earlier System/360s. Late System/370 models possess virtual storage. Composed of innovations in hardware and software, virtual storage enables a programmer to feel he has the entire machine at his disposal.



How dense is dense? When magnetic disks were first introduced, it was possible to pack 1,000 bits of data per square inch. Today disks store 4,040 bits per square inch. But another technology called magnetic bubbles—still in the research stage —may increase density even further. Bubbles are tiny magnetic regions found in certain thin magnetic materials.

Computers help get things done

In the years ahead, we can expect computer usage to grow apace. Processors and data storage devices will have instant access to a vast storehouse of information and computing power via remote terminals linked to data centers via telephone lines or radio waves. This is the new growing world of data networks and data communications—of computing on-line and in real-time. Indeed, significant examples are already evident.

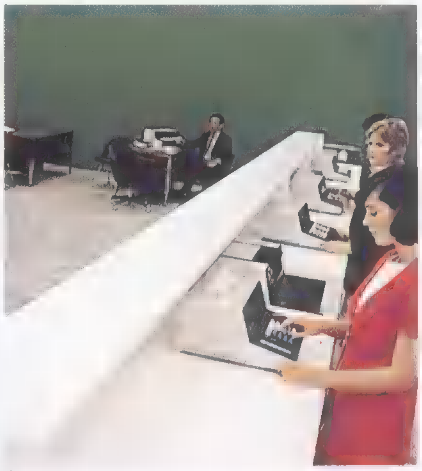
A warehouse contains millions of different items. But inventory information is up-to-the-minute with terminals that keep track of what has been shipped in and out.

Time-sharing allows many terminal users to share the same data in the same computer system. Scientists and students can gain access to the computer from their own terminals as if each were the only user at a given time.

The investment advisor checks the current status of customer portfolios against market quotations. With updated data, he can make prudent and timely investment decisions.

→
Hospital administrators and doctors can now obtain patient information and process records with ease.

←
Running a chemical processing plant calls for instant information, fine control. An IBM System/7 responds to stimuli—heat, light, humidity, weight. Thus, a plant engineer can monitor the entire ongoing operation from a remote site.



↑
Special banking terminals enable banks to clear checks, update customer accounts, even transfer funds electronically.

Faster, Smaller, Cheaper

The chart shows how data processing costs and time have declined during the past two decades. It represents a mix of about 1,700 computer operations, including payroll, discount computation, file maintenance, table lookup, and report preparation. Figures show costs of the period, not adjusted for inflation.

	1955	1960	1965	Today
Cost	$14.54	$2.48	$.59	$.28
Processing time	375 sec.	47 sec.	37 sec.	5 sec.
Technology	Vacuum tubes Magnetic cores Magnetic tapes	Transistors Channels Faster cores Faster tapes	Solid Logic Technology Large, fast disk files New channels Larger, faster core memory Faster tapes	Monolithic memory Monolithic logic Virtual storage Larger, faster disk files New channels Advanced tapes
Programming	Stored program	Overlapped input/output Batch processing	Operating system Faster batch processing	Virtual storage Advanced operating systems Multiprogramming Batch/on-line processing

Today. Tomorrow

A desk-size computer today can often produce the same amount of work as a computer that once occupied an entire room. The secret lies largely in the integrated circuits. We can pack thousands of microscopic circuits on a silicon memory chip smaller than a tiny pencil eraser.

As circuits become smaller, their ability to process information grows. With smaller circuits, calculating speeds also rise. And as density and speed increase, computing costs go down. The result: many times faster processing at a fraction of the cost.

The same technology that drives down costs also improves reliability. Statistically speaking, some computer components today can run continuously for millions of hours without failure.

Meanwhile, progress in programming languages is making the computer easier to use. Someday soon people may be able to tell the computer in their own words what they want it to do.

What's ahead? Many more users at terminals linked to computers. Electronic machines being used in many more ways to help people work better together in an ever more complex world.

IN BRIEF

A better way to go

Two years ago, when Mike Klein, now a System Products Division plant engineering manager, was transferred from Kingston to Poughkeepsie during a company consolidation move, he found himself driving 56 miles a day, many of them behind the exhaust fumes of the empty garage-bound Mountain View shuttle bus that carries IBM employees on company business between the two locations.

Klein reasoned that there were lots of other IBM commuters in the same boat, when they might all be better off in a bus instead, comfortably reading the paper and leaving the driving to others. He began some serious discussion with fellow commuters and later put in a call to the bus company.

The Puff Bus Associates, Inc. (it was incorporated in September) began with one 44-passenger bus; it has expanded to six, carrying 301 passengers. "We've found," explains Klein of what would seem to be an overload, "that due to business trips, overtime, etc., we can safely and regularly schedule 56 people for a 44-passenger bus."

The corporation's $25 stock is limited to one share per commuter. If a stockholder leaves the group, the stock is sold to the next name on the waiting list. Riders also pay a monthly fee of $28.

The tiny company hasn't made any money; it's nonprofit. But it holds an outstanding corporate record. Assets: 4 million passenger miles without an accident of any kind. Savings: 250,000 gallons of gasoline. And, like some larger corporations, it has created jobs for its vendors.

Up to date on data base

A recurring problem in computer technology is that specialists in various areas, like the Lowells and Cabots of historic Boston, seldom go beyond their own circle for meaningful conversation. The result is that marketing people often feel that development people are not in touch with the very real problems of the end user; development people, in turn, are sure the "marketeers" and applications people don't fully comprehend the complexity of the technological problems posed. And we all know, don't we, that pure research inhabits a blue sky of its own?

In December, with a view toward clearing a communications path toward a common grail, a large group of specialists from Corporate Headquarters, the Data Processing, General Products, Research, System Communications, and System Products Divisions met in San Jose for a 3-day exchange on data base systems.

Under the chairmanship of Jerrier A. Haddad, IBM vice president of engineering, programming and technology, the symposium was more successful, says one specialist, "than one has a right to expect. Such a large group could easily have polarized, but it didn't." In feedback to CHQ's Ron Ashany, symposium coordinator, and program chairman, GPD's Larry Cohn, many called it the best conference they had ever attended, inside or outside IBM.

The structure of the computer's rich information lode and the ways it is tapped is one of the most critical issues in computer technology today—as the ranks of less sophisticated users grow. Chris J. Date, a project programmer with IBM U.K. in Hursley, on temporary assignment with GPD in Palo Alto, who received a red-Morocco-bound copy of his *An Introduction to Data Base Systems* at the conference, attributes his book's popularity to high interest in its subject matter. (One of six published in The IBM Systems Programming Series, the book has sold more than 10,000 copies worldwide and is used in 57 colleges.)

"It's a new subject, an important subject, and an interesting one," says Date. "And it has a lot of social implications. Sooner or later, data base is going to affect everybody."

Lone eagle

Benjamin Franklin regretted the choice. He wanted that "true original native of America," the turkey. Even so, since 1782, thanks to the Founding Fathers, the bald eagle ("bald" refers to its white headfeathers) has been America's national symbol.

It's the only *eagle* native to this country. And something about the way its great wings, which can spread to a range of 6 to 8 feet, lift in the air—and the heights they soar to—captured the imagination of both the early Indians and later generations of Americans, who followed the eagle into the skies. They named their heroes after it.

But the birds, once numerous, are fast going the way of the dodo and the whooping crane. Pollution, pesticides, and pot-shooters have taken their toll. Today, outside Alaska (home for about 6,000), Northern bald eagles have diminished to no more than 2,000; and their 600 Southern counterparts are found mostly in Florida sanctuaries.

The National Wildlife Federation, which protects the eagle by law, is setting up a computerized databank in its Washington, D.C., headquarters.

As a Bicentennial project, with a System/370 Model 135, and a grant from the Exxon Company, the databank, directed by an ornithologist, will provide scientists scattered around the country with a quick clearinghouse on eagle information, including the effects of various pesticides and other environmental factors on eagle survival.

The news should come as a relief, not only to eagle lovers, but to aesthetes everywhere.

After all, a turkey may be tasty, but can you imagine a gobbler spread-eagled beneath the American shield, with an olive branch proper in its dexter talon and a bundle of 13 arrows gray in its sinister?

A studio for the teacher

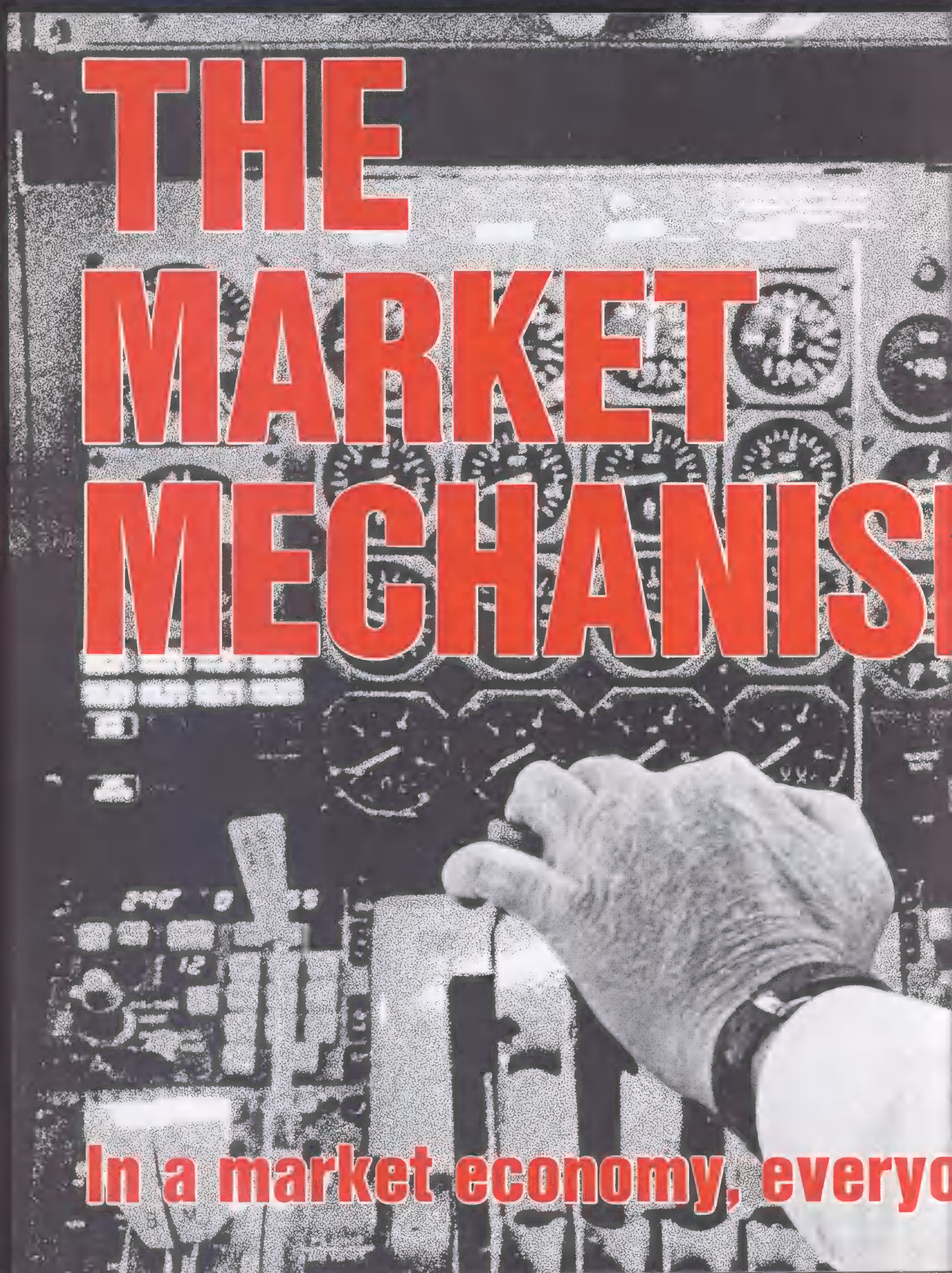
That's IBM Senior Vice President Warren C. Hume, all right. But you'll probably never guess where he is. If you said a television studio you'd be only half right.

He's at a teacher's desk. It's in one of two closed-circuit two-way Interactive TeleVision studios at the Data Processing Division's New York City Advanced Education Center. Thomas Turner, the center's senior instruction manager, is showing the IBM executive, who dropped by not long ago, how any one of the center's instructors can—by pushing the right buttons—appear on screen in a dozen customer classrooms simultaneously. The instructor can also receive and answer student questions.

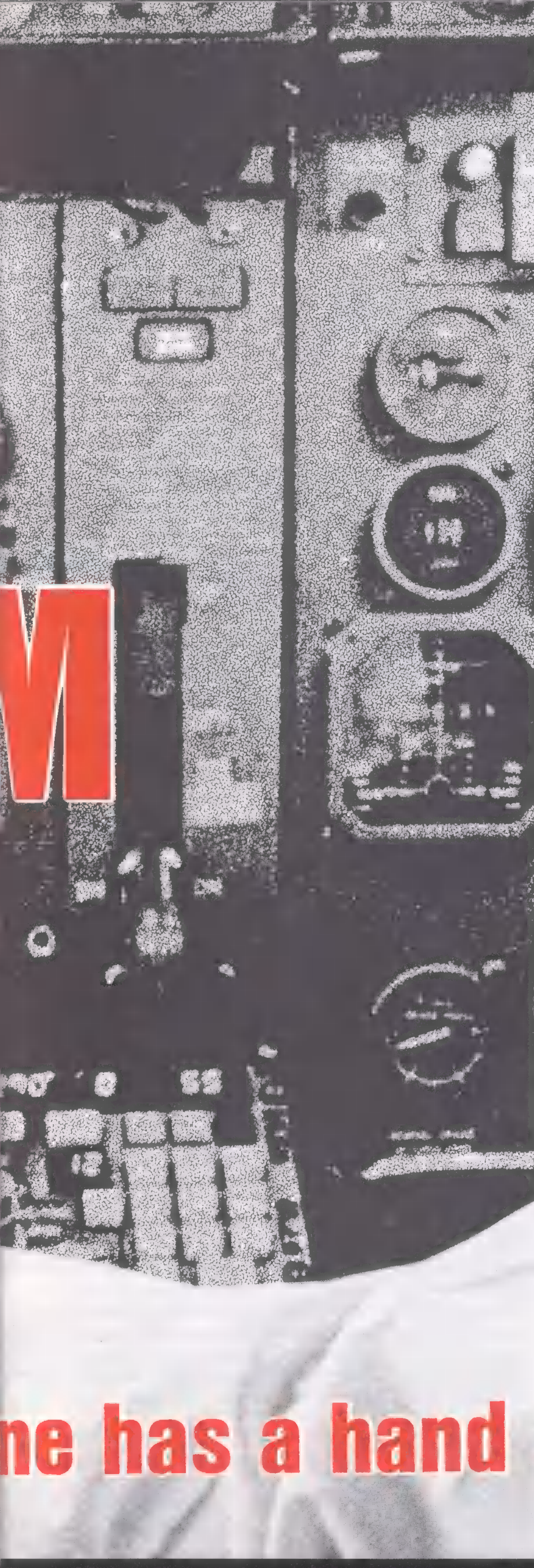
Classrooms are small (about eight customers to each), which enables students to work closely together and, the center has found, learn more quickly. The expressed enthusiasm of the more than 800 IBM customers who have used the system, to date, has been matched by sharply ascending grades.

by CLAIRE STEGMANN

THE MARKET MECHANIS



In a market economy, everyo



M

Part IV IN THE SERIES ON BUSINESS AND HOW IT WORKS

Almost every year—but especially in a Presidential election year—business finds itself in a tug-of-war between those who see it favored at the expense of public well-being and those who argue there can be no well-being without a thriving business system.

This year bids to be no different. The rhetoric is already warming up.

All the more reason to understand that the U.S. economy is a very delicate and subtle machine. One that has evolved slowly, and with some pain, but without central planning, with everyone doing his own thing. All the more reason, too, to understand that it is still evolving and accommodating itself to the changing demands of the American people.

"We can foster this evolution in desirable directions," concludes Harvard University's Robert Dorfman in a postscript to his fundamental work, *Prices and Markets*. Or, as he says, "we can throw sand in the works. The better we understand this machine, the less likely we are to damage it."

In this issue, veteran business journalist George Cruikshank poses some provocative questions to Professor Dorfman. Do prices and competition *really* work to accommodate the forces of supply and demand? And how can we be sure that our fast-dwindling resources will be allocated wisely by the market mechanism?

Professor Dorfman gives some unconventional replies. He sees the U.S. system facing a number of problems. Ad men will not like what he has to say about some forms of advertising. And he is concerned about what he sees as a natural tendency of the American system to concentrate power in large-scale engines of production.

At the same time, Dorfman shares with other leading economists, who are appearing in this series, the firm conviction that the system is durable. And that, for all of its many ills, it nevertheless is better, more plenteous, more productive than any other.

It has been said that when four economists get together, you are likely to get five points of view. *Think* hopes that, by presenting sometimes diverse and divergent views, it will help you to reach your own conclusions about the directions our economy should take.

Section edited by ROBERT J. SIEGEL

ne has a hand on the throttle

THE MARKET MECHANISM

How pricing keeps the twin engines of supply and demand in synch to make the system work. A provocative interview with Harvard University economist Robert Dorfman.

Professor Dorfman, the U.S. economy produces more goods and services than any other in the history of the world. What is its basic strength . . . what makes this possible?

We are an uniquely fortunate country. No other country has such a rich endowment of fertile lands, moderate population, oil reserves, iron and coal deposits, and many other resources. But natural resources are not the full explanation; Argentina and Russia, for example, are also richly endowed but do not prosper the way we do. We also have the advantage of an exceptional cultural and social heritage—of a tradition of democratic government and of individual economic initiative and enterprise. All those things together make it possible for us to enjoy a standard of life that is the envy of the rest of the world.

Just why do you think the contribution of individual economic initiative and enterprise is so important?

Because an economy is such an intricate organization that in order to run it at all effectively you have to enlist the brain-power and energy of millions of individuals. Billions of decisions have to be made every day. Now the trick is to spread around the work of making these decisions, to give each decision-maker the information that he needs, to avoid confusing him with a lot of information that he doesn't need, and to motivate him to make the decisions that contribute to the efficient operation of the whole economy—producing the goods and services that people want without wasting resources.

Historically, you know, our independent enterprise economy just happened. It evolved in the course of three centuries out of the late medieval merchant guilds, and is still evolving. That was very fortunate because no mere mortal could have invented it—no utopian scheme that I have ever seen was half as ingenious or promised to be a third as effective as this system is.

What is it that makes the system as ingenious and efficient as you say?

Wait a minute. I may have gone too far. The system is remarkably efficient when you take into account how complex its task is, but it isn't perfect. There's a great deal of waste in it and some problems that it doesn't contend with very well at all. I'm thinking of our current problem of unemployment and the continuing problem of making adequate provision for the future. And also the problem of great, and sometimes unfair, disparities in income and wealth.

But in spite of those problems, what the system does is amazing. And it does it by a very simple device. It simply tells each businessman—who knows more about his enterprise than anyone else can—to produce the things that consumers are willing to pay most for, and motivates him by allowing him to keep the receipts. It also tells him to produce his products as cheaply as possible and to keep for himself any savings he may achieve. Then it turns out, by a chain of reasoning that takes most of a university semester to explain, that those are exactly the right instructions to give to make the economy work efficiently.

I can see that it makes sense to have businessmen decide how much to produce of all kinds of consumption goods. But how about the broader questions—the so-called social issues—such as how much money do we spend on medical care for old people, how much on rebuilding decaying neighborhoods, how much on protecting the environment, or on education?

Those are important examples of the kinds of decisions that individual en-

Dr. Robert Dorfman is David A. Wells Professor of Political Economy at Harvard University, and author of Prices and Markets *and* The Price System. *He was interviewed for* Think *by George Cruikshank, formerly with* The Wall Street Journal *and* U.S. News & World Report, *and a writer on business and economics.*

terprises can't be relied on to make. The reason is that the importance of those social goals is not conveyed automatically to businessmen by prices, in contrast to the importance of things that consumers buy for themselves. Those decisions have to be made by political means and carried out by government procurement, by taxes, subsidies, government regulations, and so on.

But doesn't such action by government interfere with the free market economy?

Yes. But there are many other forces that interfere with the so-called free market. Despite all the neat categorizations in economics textbooks, there is no such thing as a free market economy operating in this country or anywhere else. Nor has the free market ever operated in the past.

It's important to define a pure free market economy. What economists mean by that is an economy that is typified by having its commodities produced by a large number of industries, where there are many firms in each industry, and purchasers have weak preferences for the products of the different firms so that if there is any significant difference in prices, consumers will choose that firm's products that are the cheapest.

There are two other conditions. One is that the firms themselves decide on their prices independently, in the sense that each, in choosing its price, believes that the other firms that compete with it will not react, and that it is free to choose whatever price seems most profitable to it without affecting the prices chosen by its competitors.

The final condition is that the government does not interfere with the operation of the markets for any of these industries.

Quite obviously, under your definition, we don't have a free market system. What, then, do we have?

There's no good descriptive word. A popular phrase, though hardly definitive, is a "mixed" economy. You might also call it a "tampered with" economy. It is a mixture, with elements of competitive free markets, with a large and seemingly growing role of government in the economy, and with interferences and complications in the system brought about by businesses and labor organizations.

What are some examples of markets which you would define as purely competitive in the strict "free market" sense?

Oh, I would say these industries have many attributes of a free market: women's clothing in manufacturing and wheat in agriculture, to cite a couple. In such industries there are many small firms, and the products of one are virtually indistinguishable from those of any other.

But the broad range of industry . . .

Although there certainly is competition in the broad range of U.S. industry, we don't have what an economist would view as "perfect" competition. This is chiefly because modern methods of mass production and mass marketing tend to be incompatible with pure competition. Modern methods of production require large amounts of fixed capital equipment and tend to be characterized by decreasing long-run costs. That is, a large plant operating at its most efficient volume of output will have lower average costs than a small plant operating at its most efficient level of output. When these technological conditions obtain, even an industry that starts out with perfect competition will soon evolve into some other market form, because the firms in it will tend to grow in order to reduce their costs of production by operating larger, more efficient plants. This is true of the entire Western world.

By "other market forms," are you referring to monopolies and oligopolies?

A monopoly, as everyone knows, is a market in which all or virtually all of a commodity is provided by a single seller. An oligopoly is a market in which there are a few firms, each of which recognizes that its actions have a significant impact on the price and supply of the commodity. Railroads and utilities are monopolies and are, of course, heavily regulated by government. Examples of oligopolies abound in almost everything produced by industry in the free world—from cars and cameras to dishwashers and jet aircraft.

Are you saying that there is no true competition in such major industries?

No, they compete. But my point is that oligopolies are peculiarly rigid, and in an economic sense, less responsive to market conditions than a purely competitive market with thousands of producers. Take automobiles. It used to be a rarity to see foreign cars on American streets. Now they are prevalent, especially in the small-car categories. American auto makers for a long time didn't—or couldn't—meet demands of the open market, which I think was calling for smaller, cheaper cars.

But the competitive market ultimately did work, didn't it? Foreign auto producers came in and grabbed a significant chunk of the U.S. auto market. And American producers responded by competing.

Well, I suppose you could say the market worked if you're a patient person. After all, it took a long time before U.S. producers really paid attention to market signals. Besides, there are many other reasons for concern about oligopolies. For one thing, they are practically compelled to dissipate economic resources.

Compelled? For example?

As an example: advertising. The function of advertising is to make the consumers want the products advertised. But if the purpose of economic effort is to satisfy customers' desires, what can be said in favor of a market form that makes consumers desire what firms produce?

But how else would consumers know what's available in the marketplace?

I am differentiating between *kinds* of advertising. Consumers would know just the same way they know what different department stores are offer-

THE MARKET MECHANISM

ing. There is a kind of informative advertising which creates a marketplace and informs consumers. But there's all the difference in the world between the ads in your local newspaper and some of those in a slick magazine or on TV. The latter type too infrequently say anything new. But do repeat the name of the brand over and over so that the buyer thinks it is reputable, has confidence in the brand, and is not easily weaned from it. That's essentially wasteful in an economic sense, in my view.

Despite these flaws, do you think the American business system efficient and doing a reasonably good job?

Oh, yes. Our economic system—"mixed" or "muddled" as it is—remains superior to any other that I can think of. Importantly, this is so because the system is not static: It's changing all the time. Our economy is not what it was twenty years ago or even ten years ago, and it will be different still ten or twenty years from now. The system is superior because it accommodates change when an unfettered price system does not produce desired results.

Can you illustrate that last point?

The Social Security program, the minimum wage law, free public education, subsidized medical care—these are all examples in which society has decided that market forces, if left alone, would bring socially undesirable results.

But you hear complaints from consumers—about shoddy goods, faulty repair work?

The system is not perfect. Unless you want a book that's on the best-seller list, you often have trouble finding it in most bookstores. A lot of people—students, for instance—had trouble getting plane flights home for the holiday because of the recent strikes by two airlines. Clothes cannot always be found in the size, color, and style you want.

Such instances aside, however, what really impresses me is how well the system really works. Products take a lot of abuse. I have a refrigerator that has worked perfectly for ten years and I have never oiled it. I'm not kind to my automobile—I service it about a third as frequently as the manufacturer suggests—and yet the car has functioned well for eight years and rarely is in the garage for repairs. All in all, I think the American consumer gets quality merchandise. Could it be made even better? Here you would have a trade-off: a more costly product that would be more durable and reliable. Would it be worth 25 percent more to make my refrigerator last twenty years instead of fifteen?

Are you concerned about abuses of that system by big business or big labor? Is there a need for government to provide what has been called a "countervailing power?"

We do have countervailing power. Certainly, the Antitrust division of the Justice Department functions as a countervailing force. I do see a need for more government in the fields of environmental protection and in safety-related and health-related products where it appears that a free market system would not take all of the important social consequences into account. But I think we have, by all standards, a highly productive economy. One could be more productive, but at a cost.

On the subject of demand in relation to limited supplies, how serious do you think shortages—of raw materials, energy—are going to be? Can the market system take shortages in stride?

To the economist, the only possible cause of a shortage is the failure of prices to rise high enough to eliminate it. Higher prices make it more profitable for producers, who then will raise their volume of output, and at the same time higher prices will discourage consumption. A shortage is a signal chiefly that prices are being kept low by some external noneconomic force or consideration. Right after World War II, for example, there was a "shortage" of new automobiles. The auto companies, in order to maintain good relations with their dealers and public, did not charge as much for automobiles as consumers were willing to pay. If the auto companies had raised their prices, the "shortage" would have disappeared.

Is the principle the same with oil and similar commodities?

Yes. Demand falls off at the higher price; output is stimulated. Additionally, higher prices encourage substitution—plastic for steel, coal for oil, trains and buses for automobiles—and needs are met. The market accommodates. Remember, many shortages can easily be cured by allowing prices to rise—but the cure may be worse than the disease. Sometimes a shortage is better than the price rise that would take care of it.

What about the people who can't afford to pay steeper prices? Or who like the convenience of autos and oil for furnaces?

In an economic sense, they have no choice. They will have to consume less of the high-priced commodity, because there is less of it to consume; not just because the price is high. And that applies to the whole world. Many commodities are growing scarce, so we will all have to ration ourselves. Rising prices are signaling that need to cut back because Nature has rationed the whole race with respect to consumption limits.

But what of necessities? What about milk at $15 a quart?

Education is a better example. For generations, university education was so expensive that most people couldn't afford it for their children. So we broke into the system and relieved the individual of the task of paying for most of it. We could, I suppose, do the same thing for milk; we already provide items which are too costly for the average person—kidney machines, for example.

Someone has to pay taxes, of course, to support such government efforts. Is there a danger that the rising tax load on those

who produce will dull incentives?

That would be rather far down on my list of concerns. I believe that many, if not most, types of workers would perform as well even if taxes were higher. Katharine Hepburn, for instance, would not perform poorly just because her take-home pay was smaller than it is. On the other hand, heavy marginal tax rates undoubtedly do discourage desirable services—the surgeon, for example, who works only nine months a year because to work twelve months would not mean that much more to him in monetary terms.

Are advertising and other shortcomings in our system the reason prices in the past couple of years have been spiraling up at a time when demand was falling?

Prices, like hot air, have a natural tendency to rise. This has been going on since Roman times with very few exceptions. Prices are formula-set in relation to costs of production. When demand falls, if wages and rents and other costs do not fall, producers don't cut their prices. They just sell what they can at set prices. Auto companies, for instance, during the recent business slump, saw demand for autos fall sharply. They did not cut prices because they knew their competitors would follow suit and the result would be sales of about the same number of cars but at lower prices. Why do that? In the meantime, we have great swings in auto production, many thousands of auto workers lose their jobs, and economic activity is hard hit.

Is national economic planning an answer to market deficiencies?

Neither this country nor any other knows how to plan nationally. Forecasting methods are unreliable. Communist countries plan, and, even with drastic measures to make the plan work, the results are much less efficient than is our unplanned system. I would stay with our present system, meanwhile trying to improve our forecasting methods and providing businesses with all possible information so they can do their own planning. In the long run, I believe we must look to ourselves as intelligent, informed producers and consumers—in the framework of the system we have—to make our own decisions. ■

It's a superautomatic, self-regulating system

The economy is a vast enterprise for which we all work and from which we make all our purchases. Its purpose is to produce all the commodities people need and want in return for their work and the raw materials that the economy uses up.

No one decides on the quantities of different commodities to be produced by an economy such as ours. It is, so to speak, self-planned. Control engineers, who design self-regulating devices such as thermostats and autopilots, have pointed out that an economy is a gigantic self-regulator.

A control system consists of a machine that does something (a furnace), a sensing device that keeps track of the machine's output (a thermometer) and compares it with the desired output, and a control or switch (a thermostat) that changes the operation of the machine when the output diverges from the desired one. That's all there is, and all control systems are built on this simple building block.

A heating system produces only one output, heat, so it needs only one control. But an economy produces thousands of outputs or commodities, so it needs thousands of controls. Factories produce a flow of the commodity, which is sent, more or less directly, to some stores. Instead of a thermometer, there is a scale of prices. If the flow of the commodity is less than desired, its price tends to rise. This makes it more profitable to produce that commodity. Instead of an automatic switch, there are businessmen who notice the increase in profitability and respond to it by increasing the flow of the commodity from the factories. Then the price ceases to rise. It may even fall if the businessmen increase the flow more than their customers desire. In that case, the price will begin to fall, and businessmen will be induced to reduce the flow of that commodity.

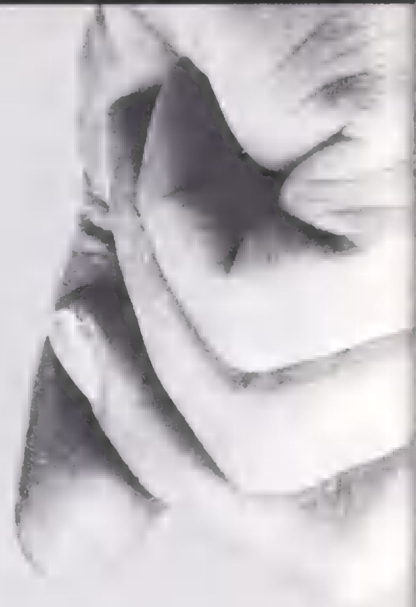
Prices in this economic control system are the sensing devices that reflect any divergencies between actual and desired output of the commodity.

The analogy with an automatic control mechanism is illuminating but, like all analogies, it can be taken too literally. There are important differences between an economy and a self-regulating machine. One of them has to do with setting the controls. In a house someone sets the thermostat to the desired temperature, and the machine then takes over and controls the actual temperature.

In an economy there is usually no one who determines the desired output of a commodity. The economic system determines this for itself. In this respect it is a superautomatic control mechanism. But the desired quantity of any commodity depends largely on the amounts of other commodities that are being produced—and on their prices. This feature of an economic system cannot be understood by looking at a single market in isolation. We have to consider all markets together, and how they interact.

In an economy, the "switches" are the businessmen who make decisions for the individual firms, and businessmen are far more intricate and unpredictable than even the most temperamental electromechanical apparatus. An economy is a control system with human intervention. Businessmen look at more than prices. They take many other things into account, including the behavior of other businessmen. By doing so, they change the behavior of the whole system.

And people have to be motivated. A businessman responds to a price or other stimulus in the way that seems advantageous to him. This is why the "profit motive" is such an important part of the economic system. It determines how businessmen respond to different circumstances, and thereby how the whole system operates.



TOP D

Can planning help smooth the occasional rough goings of a free market economy? Without throwing roadblocks in the way

BOTT

by Irving Kristol

One of the most fascinating aspects of public discourse is the way in which certain words will, in the heat of debate, become inflated into symbolic "code words"— words having different meanings for different people, with none of these meanings having much of a connection with the literal meaning. One such current instance is the controversy that rages over "busing." It is a controversy that has nothing to do with buses, but is rather about the relative degree of power to be exercised by parents on the one hand, or government on the other, over the education of our young people. It is only a seeming paradox that many parents who oppose busing are quite content to have their own children transported daily by bus to *certain kinds* of schools. It is not the bus that is at issue but its destination—and, above all, the authority to choose that destination.

Something of the sort seems to be happening with the emerging debate over "economic planning." It is not "planning" itself that is at issue but rather *who* is to do the planning and *for what purpose.* After all, everyone plans, as we are constantly reminded. The housewife plans her weekly budget; the student plans a career; the corporation plans its capital expenditures for years ahead; the government plans for all kinds of military contingencies. Is anyone against such planning? Of course not. Indeed, since such planning evidences a responsible concern for the future, and a rational attention to costs and benefits, we need more of it, not less. But when we debate economic planning, that's not the kind of planning we are talking about.

Perhaps a homely example will illustrate the dangerous ambiguities that adhere to the word, *planning*. The best kind of poker game is one in which each player is constantly engaged in the most careful planning. He makes his decisions—as to whether to stay in or get out, to call or raise a bet, to bluff or not—with reference to (a) the characters of the other players, as best he can understand them, (b) his available resources as against theirs, (c) the cards that are showing, (d) the laws of probability, and (e) his standing with Lady Luck that evening as evidenced by previous hands. No poker player can reasonably protest against *this kind* of planning.

But there is another kind of planning that will outrage him, and might even lead to bloodshed. This is when the "house" — or the host — decides that it (or he) will rig the deck in an effort to predetermine who will win, and how much. The house (or the host) might declare that he has engaged in this procedure for reasons of justice or fairness—but most poker players will not be impressed. On the other hand, if this happens to be the only game in town, what the rational poker player will do is to try to devise a strategy that will defeat the house's intentions. If *all* the poker players will do that, the house will have planned to no avail. It will then have the alternative of renouncing its plan or else dictating, by threat or force, how every player should play.

It is this latter kind of planning we are talking about when we argue the merits or demerits of economic planning. We are talking, not about individuals or institutions planning for themselves, but about *centralized* planning by the house, i.e., the government. In this kind of planning, the market for all economic activity must be rigged — if you "fix" only an occasional deck, the overall results will be unpredictable. And, in this kind of planning, too, the government will have to coerce all the players to stay in the game and to bet "right" (from the house's point of view) —otherwise the plan won't work.

But there is still another element in this situation which further confuses the argument over planning. In all "free" poker games, it is generally recognized that the house does, indeed, have a unique authority, which it may use to a greater or lesser extent. This is the authority, not only to define and enforce the rules by which the game of poker is played, but to establish vari-

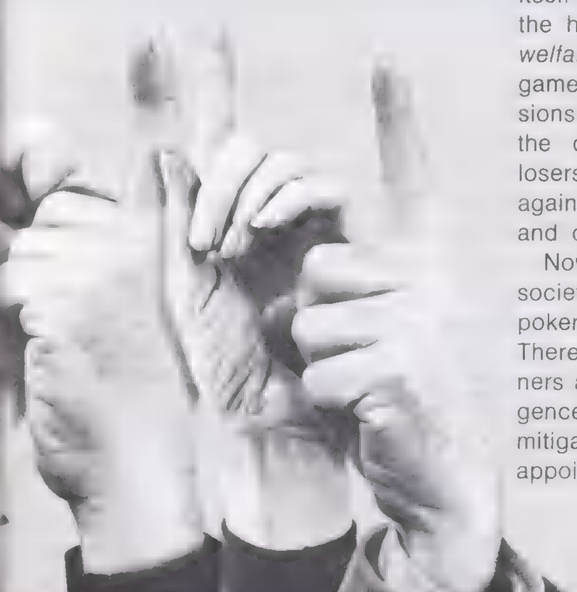
---

Irving Kristol is Henry R. Luce Professor of Urban Values at New York University. He is a member of The Wall Street Journal*'s board of contributors and has written numerous articles and books, including* On the Democratic Idea in America. *He serves as co-editor of* The Public Interest *magazine.*

OWN

of those billions of everyday decisions we all make? These are the views of one economist.

M UP



ous "limits" on individual action. Thus, the house may prescribe the maximum number of raises in any one round and the size of these raises. The purpose here is to prevent those with a lot of money from so intimidating the others as to make the game pointless—the rich will always win over the poor. In other words, the house is conceded to have the authority to *equalize opportunity*, within limits. Those limits have to be drawn in such a reasonable way as to persuade the less affluent players that they have a fair shot at winning, without making the game so dull as to negate the incentives for the more affluent to take part. Such a definition is provided by a combination of experience and common sense, and the limits themselves are usually not very controversial. This is especially true because, in a free society, there is always more than one game in town, with different rules and different limits to suit various pocketbooks and tastes.

The house, moreover, can go further by way of regulating the game, without anyone complaining much. It can, for instance, set a limit as to how much anyone can lose. It can even announce that, when a player has lost his stake, other players have to chip in a certain amount of their winnings so as to provide the loser with carfare home. Since no one wants these losers hanging around the table anyhow and dispiriting everyone else, most winners won't mind being "taxed" for this purpose—just as they don't mind being taxed by the house to help pay the cost of the security guards who protect the game itself from predators. In other words, the house can make provision for the *welfare* of losers without subverting the game itself. Of course, if these provisions are so generous as to extinguish the difference between winners and losers, no one will wish to play. Here again, the limits are set by experience and common sense.

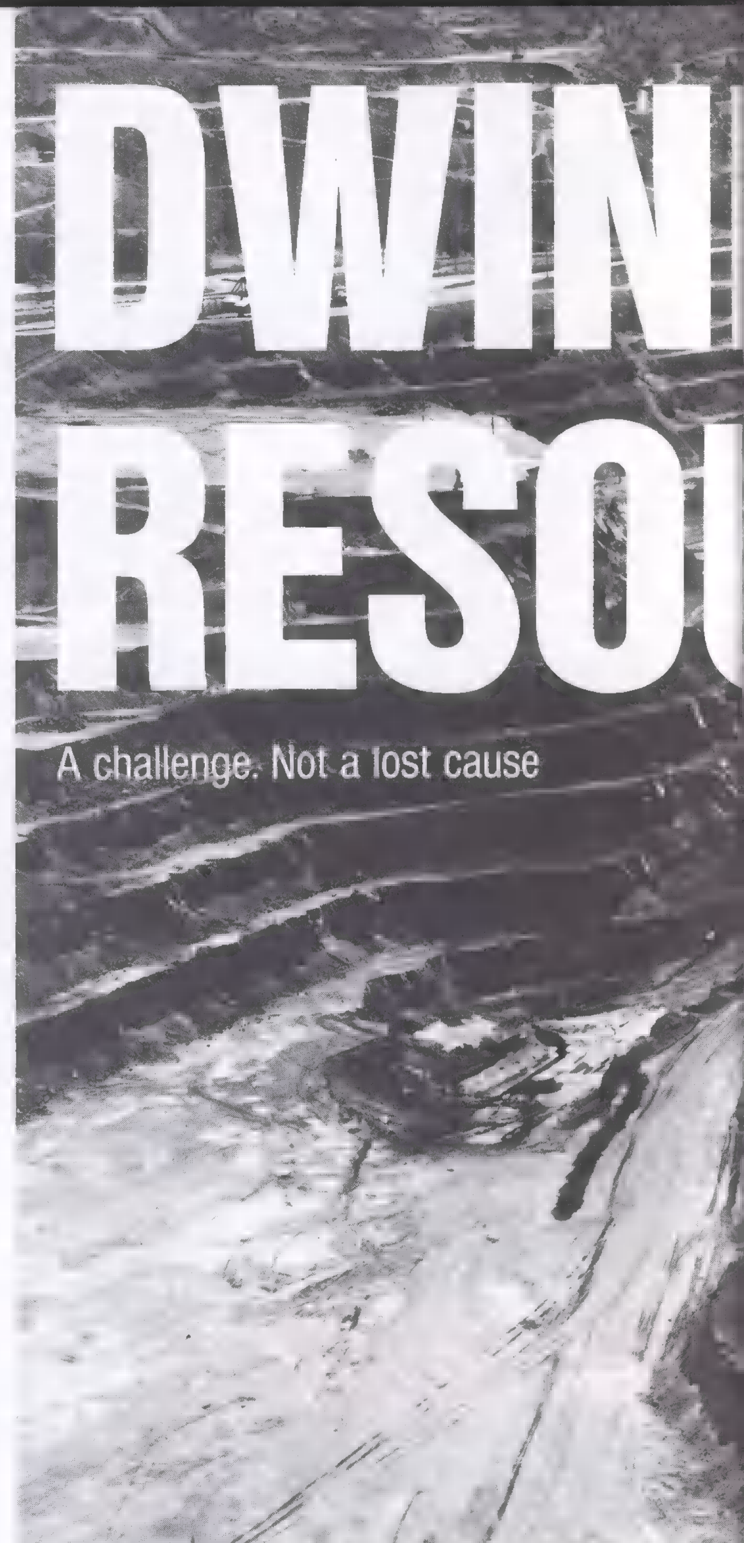
Now, a market economy in a free society is very much like the normal poker game we have been describing. There are risks and uncertainties, winners and losers—with character, intelligence, and luck all playing a role. To mitigate the human suffering and disappointments that will surely result, and to make the process somewhat "fairer" and more humane than it otherwise would be, the government assumes the obligation to encourage equality of opportunity and to make decent and compassionate provision for the welfare of the losers. Such a democratic welfare state is perfectly compatible with a free society. But when that state begins to be enchanted with the prospect of centralized economic planning, it is talking about a process which is in the long run clearly incompatible with individual liberty. If such planning is merely indicative and suggestive—as some propose—it won't be planning at all: A democratic government is not an authoritative church, and its suggestions do not move the citizenry to prompt obedience. If such planning is coercive, then it is not compatible with a liberal society.

Behind the current enthusiasm for economic planning are two curious assumptions. The first is that government officials, being better informed than the average citizen, are in a better position than he is to know what his needs really are. This is doubtless true in some individual instances, and there is no need to be dogmatic about governmental intervention in the marketplace. But if it is generally true, then there is no case for liberal democracy at all. A liberal democracy, if it is to mean anything, must mean that most citizens, most of the time, are capable of defining their own needs and are capable also of planning, either as individuals or in free associations, to satisfy those needs.

The other curious assumption is that centralized economic planning is more "efficient" in encouraging economic growth and in coping with economic developments than is the free market. As it happens, the world is populated with all sorts of planned and semi-planned economies, and yet none of them is ever pointed to as a striking instance of the wonderful things planning can accomplish. Nor do the citizens of those nations go around boasting about the achievements of their planned economies.

So the advocacy of planning, in certain circles in the United States, may be taken as merely substantiating an old saying: When ideas die in Europe, they come to America to be born again. ■

by Sterling Brubaker



When the "no gas" signs were hung out at filling stations two winters ago, a lot of Americans understood the meaning of the word "shortage" for the first time. And this rude jolt came not long after the well-fed American public had been bruised by a quantum jump in farm prices following the "Great Grain Robbery" of 1972—an event that made a dent in the waistline as well as the pocketbook. All of this came at a time when prophets of doom were abroad in the land, warning that we lived beyond our means and the day of reckoning was at hand.

Until the middle years of this decade, Americans took the earth's resources for granted. Have we now crossed the great divide: Are shortages and supply-insecurity a new and enduring prospect for the future?

Those who take a pessimistic view point to the ominous arithmetic of exponential growth in population (especially in developing nations abroad) and consumption. They point to the environmental implications of such growth, to the finite character of most resources, and to America's growing dependence on foreign supplies in support of their position. The prospect of interminable exponential growth would indeed be sobering for America. It is estimated that in the past 30 years, Americans have consumed more minerals and mineral fuels than all of mankind used in all previous human history, and this rate could double by the end of the century.

But that's not the end of it. The voracious American economy is now being overtaken in consumption of raw materials by other developed countries, especially in per capita consumption of food and metals.

Although many economists do not share the pessimistic view, their optimistic argument sometimes seems to be reduced to "something will turn up—it always has." The London *Economist* frequently has observed that in post-World War II years, shortage invariably has been followed by expansion of output and worldwide glut.

An argument could be made for some optimism. Study of long-term resource availability has shown that from 1900 to 1970, resource commodities generally have been available to the American economy at stable or declining real prices. Certainly on a global basis there are resources in the ground to meet prospective needs over the next decade or so and in most cases out to or beyond the end of the century. In the short term, there may be spot shortages of some materials due to supply imbalances—especially the supply of energy, which is hinged to the political/economic vagaries of the OPEC nations. But if we learn to organize ourselves effectively to bring known resources into use, the *Economist's* assessment is likely to be borne out once again. In fact, metal and food prices have already receded somewhat from their dizzying heights of a year or two ago—a sign of ample supply. The continued strength of energy prices is largely due to cartel control of price, rather than inadequacy of supply.

The smooth functioning of an industrial society does not readily tolerate interruption in the supply of basic materials or energy, especially if it occurs abruptly. However, the normal market mechanism does adjust to less drastic changes in supply and demand conditions. A market signals shortage by an increase in price. Increased price sets in motion a chain of adjustments that bring about a new equilibrium. One effect is a reduction in demand as consumers find that a given income will not go as far. Or buyers may substitute other materials for those that have become more expensive—plastics for metals, or hamburger-helper for the real thing. At higher prices it often pays to conserve or recycle materials or invest in new production facilities for the material in short supply, drawn by the promise of better returns at the higher price.

Adjustment is not instantaneous—there is much inertia in the

Dr. Sterling Brubaker is a senior Fellow at Resources for the Future, Inc., of Washington, D.C. His most recent book is In Command of Tomorrow: Resources and Environmental Strategies for Americans, *The Johns Hopkins University Press.*

pattern of resource use. A foundry built to work one metal may not switch easily to another, and we will continue to drive the old gas-guzzling car even though we won't eventually replace it with another gas guzzler. Even adjustments in diet come hard. The resource use pattern may be fairly stable over the short term, but it can be modified, given a little time. Further, if we can compete for what we need on the world market, the adjustment may not even be very painful. For example, we have accommodated a fourfold increase in international oil prices and a doubling or tripling of domestic grain prices in recent years. With some stress—true—but without crippling effects.

If supply were a purely commercial matter, then the short-term problem would be fairly simple; but it may be more than that, especially if we must look abroad for minerals and fuels. At one time industrial countries could pretty well set prices and terms for raw materials. They had to meet production costs, but thanks to political domination over the colonial world, they paid little rent to the producing country for use of the resource and they brooked no interference with supply. That arrangement vanished when the sun finally set on the British Empire.

Today, less developed countries aggressively seek to maximize their returns from resource production. Few have been so successful at controlling supply and raising prices as the OPEC oil combine, but others try one device or another—a tin agreement, a coffee agreement, a copper exporter organization, or unilateral attempts to raise the prices of bauxite and phosphate. To struggling poor countries with a foreign mineral producer as an enclave in their midst, the foreign firm becomes a tempting target for demagogic appeals; it is especially vulnerable after a large fixed investment has been made. In consequence, mineral-producing firms become cautious about investing abroad, and supply is further hindered. Solutions are possible, though.

There's been a consistent failure to recognize how effective our economy is at finding new supplies, or exploiting abundant supplies of lower grades of ore. And we can ease the foreign supply problem by a variety of actions, ranging from stockpiling to meeting the aspirations of foreign suppliers for higher prices and more favorable economic treatment.

But if we are to deal effectively with these shortages, it is important to recognize that minerals and energy supply are long-term problems. Even if we are only using existing technology, it may take five to ten years to bring a new mine or oilfield into production. With new technology, the gestation period can be significantly longer.

Increasingly, the market requires a policy or planning framework—and even the collaboration of government—if the free enterprise system is to produce results which are consistent with national needs. Two examples will illustrate this point. Production costs of Middle Eastern oil are very low, and only the existence of the cartel maintains prices. Will U.S. investors agree to develop high-cost domestic energy resources without some assurance on domestic prices? Or look at nuclear energy. While private firms are now lusty participants in this industry, they could not have undertaken the research and development over the time period or on the scale required to make it commercial. Yet nuclear power may well prove essential to further growth of the economy.

What we face is a continuing challenge to human ingenuity. Over the longest term, reduced consumption is not an answer.

We will have to perfect technology that permits use of ever lower grade ores and materials and readily available, inexhaustible energy resources if we are to perpetuate an industrial society into the indefinite future.

Because it takes so much time to develop and deploy such a technology, society cannot rely exclusively on short-term market mechanisms. And because a huge investment is required, a sufficient portion of our existing stock of high-quality resources—a form of natural capital—must be converted into the technology required to meet long-term needs. This "seed resource" cannot be squandered on current consumption.

I believe that this is a major challenge for the rest of the Twentieth Century. A challenge which has yet to be faced squarely by our society or by its political leaders. ■

NEW LAND NEW HOMES

For 130,000 Vietnam refugees, an IBM computer helps pave the way

by Edward F. Pierce

It's quiet again at Indiantown Gap in southeastern Pennsylvania.

The scores of barracks, the dining halls, the recreational halls, and other facilities that made a temporary home for thousands of people are silent. The streets of the old Army camp are deserted.

Farther south, in Arkansas, the last temporary residents have left Fort Chaffee, and that base is once again being mothballed. Camp Pendleton in California and Eglin Air Force Base in Florida have resumed their full-time military roles.

Except for the completion of some final wrap-up details, the job of the Federal Government's Interagency Indochina Task Force was completed, on schedule, at the end of the year. In slightly over six months it received, housed and fed, interviewed and found homes and jobs for some 130,000 Vietnamese refugees from the fighting in Southeast Asia.

The work of thousands of volunteers in humanitarian agencies throughout the United States is finished and they have returned to their normal pursuits.

Also returned to normal status, their work completed, are an IBM System/370 Model 158 and 43 display terminals that had been on loan, without charge, to the task force to help with the relocation effort. The donation, including basic programming, training, start-up assistance, and systems engineering support, was known as the IBM Indochina Refugee Project.

It all started on May 2, 1975—a Friday—when a request came to Armonk from Washington. Was there any way that computers could help in processing the oncoming refugees from Vietnam and other countries in Southeast Asia? The trickle of refugees that started in April had grown rapidly as it became apparent that the war was nearing a climax. By the time Saigon fell on April 28, the situation was chaotic. All that was known was that the refugee camps on Guam and Wake Island were swamped, that thousands more were on the way by ship and plane, and that relocation centers in the United States would soon be inundated.

And, asked Washington, if computers could help, would IBM be willing to provide some equipment and know-how? IBM Chairman Frank T. Cary asked Walton E. Burdick, IBM vice president, personnel plans and programs, to respond to the request.

"There was no question that we could help," recalls Burdick. "The need was great and immediate. The Government Task Force, with limited funds, was faced with carrying out a national commitment. And IBM had given similar assistance back in the 1950s when many refugees came to this country after the Hungarian uprising."

He enlisted the aid of two men with long experience in government operations: Don Swedenborg, director of scientific and social marketing, and Mike Doré, national marketing manager, both of IBM's National Federal Marketing organization.

On the very next workday, Monday, May 5, Burdick, Swedenborg, and Doré called on the State Department to hear specifics of the requirements.

Things moved swiftly.

May 7 — Corporate staff heads meet in Armonk to hear of the requirements and plans. They are asked to respond with recommendations by two o'clock that afternoon.

May 8 — Burdick returns to Washington to make specific arrangements. Basically, the terms of the loan called for no payment of any kind to IBM, and for the Government Task Force to have complete responsibility and control of the project. They are accepted.

Also on May 8, Pat O'Brien, manager of development assurance, DPD, is appointed technical manager of the project, and the hardware system is ordered. Field Engineering people design the machine room layout in an IBM branch office building in Bethesda, where the computer will

From a U.S. State Department press release, January 19, 1976:
"The IBM computer center, which served as the 'nerve center' of the Interagency Task Force for Indochina Refugees, will close . . . after helping relocate more than 130,000 Indochina refugees in eight months.

" 'We are grateful to IBM for this significant contribution. Without the computer system and IBM's people, the voluntary resettlement agencies most likely would not have been able to match sponsors with the refugees by the end of 1975,' said Julia Vadala Taft, Director of the Task Force . . ."

be installed until the Government can find a permanent site.

May 9 — Shipment of computer units gets under way from Data Processing plants across the country. This was for a System/370 Model 145. It was later replaced by the 158 as the number of refugees and amount of information became greater than expected.

May 12 — The IBM software team meets with task force personnel to firm up programming needs and approach.

May 13 — Computer equipment starts to arrive.

May 14 — All mainframe and input/output equipment on site. Field Engineering people start working around the clock to complete installation by May 16, just 14 days after the original request.

At that pace, the normally time-consuming and carefully coordinated job of drawing together the equipment, the programming, and the operating organization was compacted.

By mid-May, the IBM 3270 display terminals were being installed. Eventually, terminals would be located at the four refugee camps and some 20 other sites, including the Department of Defense, Department of Labor, Interagency Task Force, Immigration and Naturalization Service, and Department of Health, Education and Welfare in Washington; and at volunteer agencies' headquarters there and in New York City.

There was one slight hitch. The idea of using a computer was not received with universal enthusiasm. Recalls Doré: "In some of the agencies people were not familiar with computers and what they could do. So we had to do some training to make them comfortable with the equipment.

"Hampton Edwards [an associate systems engineer who worked full time on the project throughout its existence] visited the agencies and did a great job of training and demonstrating that the terminals would be a useful asset. He also helped assure them that the computers would do nothing more than the 'mechanical' work, and that the final decisions affecting the people would be solely theirs to make on an individual basis. That was an important consideration."

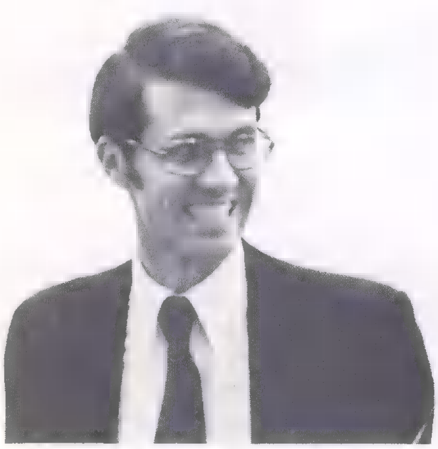
As a computer application, the refugee relocation process was relatively uncomplicated. Information about families and individuals (backgrounds and skills ranged from highly educated professionals to peasants and fishermen from small, isolated villages) was stored in the computer, as was information about job opportunities, living facilities, and other data about communities, organizations, and individuals offering to sponsor the refugees.

On demand, authorized personnel at reception centers or agencies could query the terminals, and the computer would report on the most likely match-ups. In several instances the computer system helped reunite families separated during the evacuation.

Except for Doré and Edwards, the other IBM people who were instrumental in getting the "volunteered" computer system on the air returned to their regular jobs as they completed their particular tasks.

However, there was one more "clean-up" operation in store for all. Last October 24, they were summoned to a meeting in Washington. It turned out to be a recognition luncheon where each one received a citation expressing IBM's appreciation for their contribution to the project.

And, in November, Project Leader Mike Doré received an outstanding Contribution Award for coordinating the team that responded so quickly and efficiently to the Government request for aid. ■



Mike Doré was project leader for IBM's activity in the massive relocation effort—and received an Outstanding Contribution Award for his work on the project.

How are they doing?

In Search of New Lives 50,796 Refugees From Indochina Passed Through Fort Chaffee May 2-December 20, 1975

This somewhat poignant farewell, a commemorative plaque, is one of the few mementoes left by the transitory residents of Fort Chaffee, Ark., who are now among the 130,000 Southeast Asians relocated in just about every state in the Union (6,000 others have settled in two dozen other countries, most of them in France and Canada). There are yet thousands more refugees in Thailand, including some 3,000 Laotians, who would also like to come here.

And what of those who have come to the United States in search of new lives? So far, it has been rewarding for some, traumatic for others. "Americanization" has been smoothest for the educated—about 25 percent are university graduates—who have been able to pursue or resume careers in medicine, teaching, and other high-skill professions. For others, many of them farmers or fishermen in their homeland, the culture shock has been a more difficult ordeal. The language has been troublesome, if not mystifying, even with crash courses in English. And for those who had to leave close relatives in Vietnam or Cambodia, where family ties are binding, the burden of loneliness has been almost unbearable. (These are among the reasons why some 1,500 emigrés have, at their own request, been repatriated.)

Yet, about 70 percent of the adults from Southeast Asia now have jobs in the U.S., according to a report of the President's Task Force on Refugees from Indochina. Many of the jobs, however, are at minimum-wage level, even for former high-ranking Army officers, because of the language barrier and skill factors—and because of the generally bleak employment picture in the U.S. As a result, an estimated 15 to 20 percent of the refugees are getting some sort of public welfare assistance.

Settling in to a new life—anywhere—takes time and patience, of course. But in the long view there is hope and optimism for these refugees. As government officials who directed the resettlement program are quick to point out, these refugees are as successful as—if not more successful than—any immigrant group that has ever come to the United States.

WHAT A YEAR!

(Continued from page 13)

At U.S. Steel, whose plant business IBM has been trying to win since the late '60s, DPD marketing people spent three to four years building a sound working relationship with the customer. The effort involved people from regional staffs, design centers, DPD technical support, and education programs.

At its Gary, Ind., works, which handles more than a quarter of the company's raw steel production, the customer was faced with an important decision: whether to add to competitive medium-sized computers already installed in the plant, or to move to centralized large-scale systems.

"In May," says Jerry Nysewander, DPD account executive for U.S. Steel, "we were asked to join in a task force with U.S. Steel people to help make that decision. We were very specifically told that we were participating at our own risk, that there might not be any business opportunity at all, that we were just helping them to get a job done."

By October, the customer had decided that the operations control system for the Gary works should be on a large system. But there was still no commitment to IBM, and a second key question remained: whether the large centralized system should be located within the Gary plant, or be placed in the company's Chicago Service Center where IBM was already the vendor.

"Fortunately, we were able to convince the customer to combine the Gary work load in the Chicago Service Center," says Nysewander. Along the way, there had been demonstrations, benchmarking, and visits to Japanese and European steelmakers by DPD industry specialists to inform the customer what overseas companies were doing. There was also close cooperation between DPD's Manufacturing and Distribution office in Pittsburgh, where U.S. Steel headquarters is located, and Jerry Brookhart's team of the Chicago Metals and Manufacturing office, which has responsibility for the Gary works.

The order for two System/370 Model 168s and related storage equipment, signed December 17, is one of the most significant orders that IBM has ever gotten from a process industry customer.

What was U.S. Steel looking for? "They are absolutely convinced," says Nysewander, "that they will increase productivity and increase bottom line profit through data processing control systems. They also feel they will be able to give better customer service."

In all, the mood during the year had shifted. From the "We were in terrible shape" of an OPD branch office in April, to "There's nothing like selling when somebody's buying."

Speaking to a group of financial analysts recently, IBM Chairman Frank Cary said: "We have a lot of entrepreneurial drive in each of the divisions."

And he added: "We are a young and dynamic business and we're going to be classified as a growth business, both in word processing and data processing, for a number of years to come." □

World Trade leads the way

It was five years ago that IBM's overseas operations first topped those of the U.S. company in net profit. And last year—despite a long-lasting recession in most countries abroad—the World Trade organizations for the first time passed the U.S. company in total revenues.

Both halves of World Trade had record closing months.

In the Europe/Middle East/Africa Corporation, which exceeded all of its Data Processing objectives, the Africa/Middle East Organization was especially strong. Performance achievement leaders in Europe were Iceland, Norway, Italy, Spain, Belgium, and France. Italy recorded the largest increase in net sales for the second year in a row.

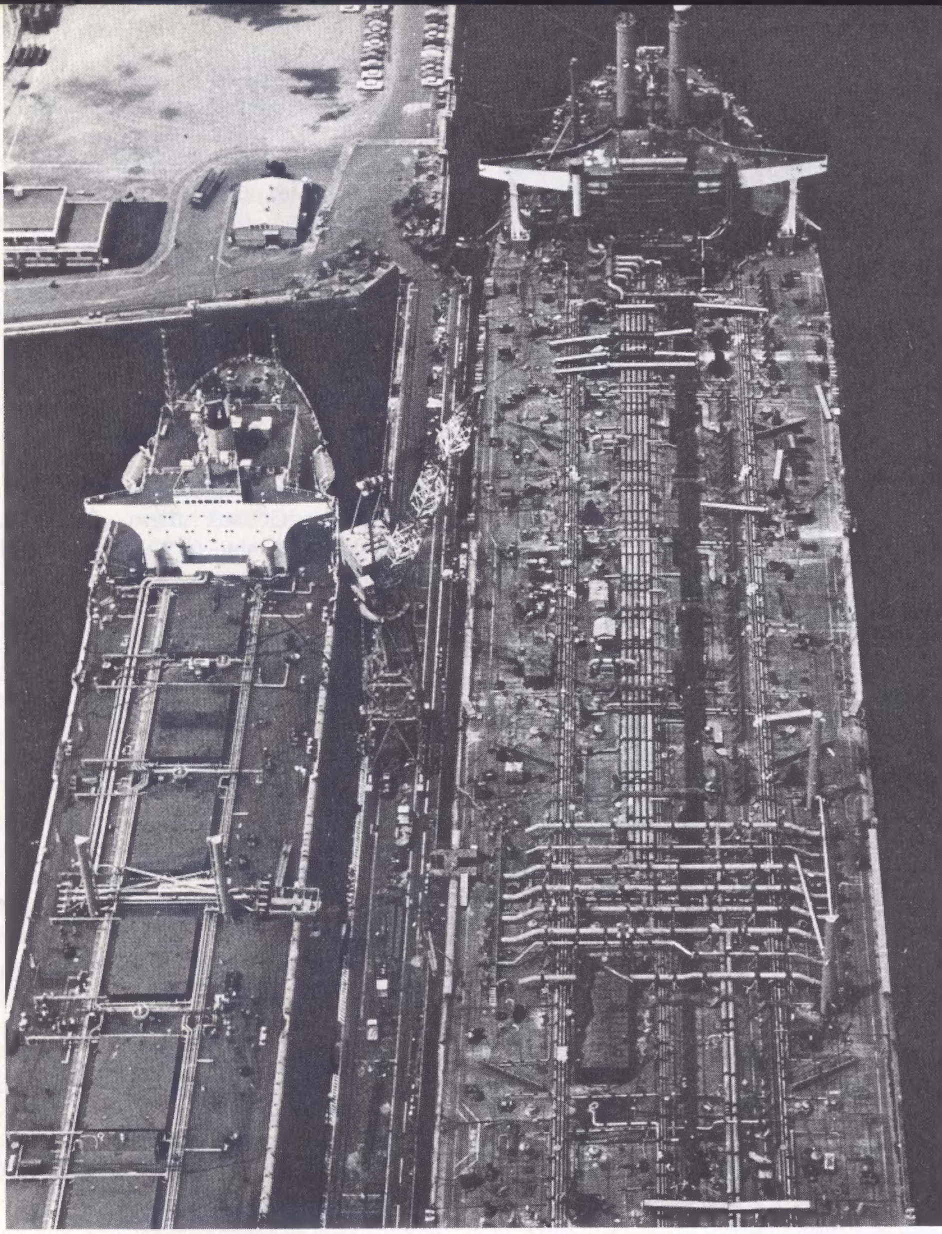
A/FE also met or exceeded all its major business targets, with Canada leading the way in quota performance among the larger countries, followed by Australia and Japan. Peru led all A/FE countries in quota performance. In total sales and installation volumes, Japan was first among all the World Trade countries for the year.

E/ME/A's success earned it the "World Trade World Cup," a friendly competition with A/FE, based on a combination of 1975 sales and financial results. A key reason for Europe's success was acceptance of System/370 Models 158 and 168. The largest order came from Italy's electricity agency, Ente Nazionale per l'Energia Elettrica. It included three Model 158s and seven 145s.

Financial institutions led the way in ordering large systems. Multiple orders included Swiss Bank Corporation, and Lloyd's Bank in the United Kingdom. The large models of System/370 also scored well in A/FE, notably in Japan, where several banks and a steel company ordered Model 168s. The largest A/FE order for 1975 came from Japan's Jyoyo Bank, which ordered two System/370 Model 168 multiprocessors.

Industry systems were standouts abroad.

Production lines in many overseas industries felt the dual pressures of rising costs and a tapering off in consumer demand. They looked to the computer as a way to keep the lid on overhead.



This sidelined supertanker was part of the somber world business picture in 1975. Customers were asking much of their equipment—and looking to computers for gains in productivity.

Quelle, Germany's leading retailer and Europe's largest mail-order company, has started to install the IBM 3650 Retail Store System in the children's and ladies' wear departments of all 23 of its stores. One hundred terminals are already in operation; another 500 have been ordered. Galeries Lafayette, the chic Paris store on Boulevard Haussmann, waited until the last day of the year to sign a contract for 400 terminals. Another large order came from the Spanish chain store, Galerias Preciados. In Australia, Grace Brothers, a department store, which installed the 3650 in October, subsequently ordered additional terminals.

Other industry systems were also doing well. Steinberg's, the Canadian supermarket that ordered the first IBM 3660 Supermarket System in 1974, ordered three more in 1975.

The IBM 3600 Finance Communication System was ordered by Caisses Populaires, a Quebec savings and loan cooperative with 400 branches, and accounts for more than 2 million members, making it one of the largest banking installations of its kind. In Brazil, a 3600 was installed by Unibanco, a large bank headquartered in São Paulo. It was the first 3600 in Latin America.

System/32, IBM's smallest full-fledged computer, was equally as popular abroad as in the U.S.

Countries in Europe that receive functional guidance from the newly formed General Business Group/International nearly doubled their new account plan, largely due to System/32.

And the figure was nearly matched in the six largest A/FE countries with GBG operations. *(See page 14.)*

In Europe, OP, helped by a tremendous surge in the last two months, finished strong, with five countries, including France and Germany, exceeding plan. All countries in A/FE met their OP targets.

Looking ahead, A/FE continues to face unsettled economic conditions caused by inflation, fluctuating rates of exchange, and import restrictions. For example:

• Inflation is running at an annual rate of 11 percent in Japan, 27 percent in Brazil, and 300 percent in Argentina. Until recently, it was rising by 1 percent a day in Chile.

• Import restrictions, resulting from local balance of payments problems, continued to pose difficulties throughout Latin America. In addition, ANCOM, a regional trading bloc consisting of Colombia, Peru, Venezuela, Ecuador, Chile, and Bolivia, is reducing trade barriers among its members and raising import restrictions against nonmember countries.

"In the face of severe economic challenges, A/FE's performance in 1975 showed we are on the track as a dynamic and growing corporation," says A/FE Chairman Ralph A. Pfeiffer, Jr. "With continued improvements in the overall economic and business climate this year," he adds, "we expect additional growth not only in our four largest countries—Japan, Canada, Brazil, and Australia—but also in the less developed countries where data processing has so much to contribute."

"We face the same economic and political uncertainties and the competitive pressures in our 17 countries that others face around the world," says GBG/I President Richard C. Warren. "But with a half-year's experience behind us and with the great momentum generated at the end of 1975, we expect a very exciting and productive 1976."

E/ME/A's Chairman Jacques G. Maisonrouge, speaking to an employee meeting on February 3, was optimistic about 1976. "The outlook on inflation is encouraging," he said. "In the major countries, we expect the rate of increase in prices to slow down." He foresaw good results from Germany, France, and countries in northern Europe; and from Italy, Africa, and the Middle East, where balanced growth is the goal. In all, he characterized E/ME/A's plans for the year as "ambitious but realistic." ■

America on Stage: 200 years of performing arts

It opened in January at the Kennedy Center in Washington, D.C., where it will run throughout the year. A fun show, and informative, too, it is a generous sampler of American drama, music, and dance through the years, from the tent shows of bygone days to the present.

The World of Franklin and Jefferson

This is the American Revolution Bicentennial Administration Exhibition, designed by the Office of Charles and Ray Eames with the cooperation of the Metropolitan Museum of Art, through a grant from the IBM Corporation. It officially opened the Bicentennial celebrations abroad when it appeared in Paris. It was also shown in Warsaw and London, and is scheduled for New York City (at the Metropolitan) in March, for Chicago in July, and Los Angeles in November.

THE MARKET MECHANISM

Part IV in the series on business and how it works

It's a superautomatic, self-regulating machine, says Harvard economist Robert Dorfman. How pricing keeps the twin engines of supply and demand in synch.
Also, 'Top down, bottom up.' By Irving Kristol. An examination of national planning in the vernacular of a poker game.

International Business Machines Corp.
Armonk, N.Y. 10504

To make sure you get Think without interruption, inform your manager, payroll, or personnel department immediately of any change in your address.

Also in this issue

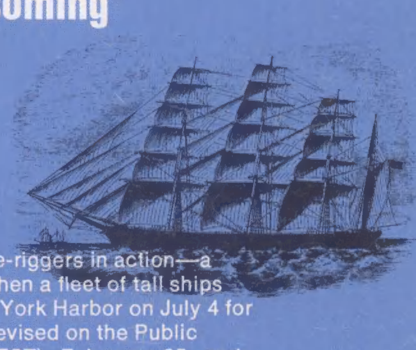
What a year!

In both the U.S. and abroad, marketing turned a bad year into a good one.

GBG goes global

For the General Business Group, a new worldwide mission.

'The tall ships are coming'



It's an IBM film of those great square-riggers in action—a preview of "Operation Sail" 1976, when a fleet of tall ships from around the world sail into New York Harbor on July 4 for the Bicentennial. The film will be televised on the Public Broadcasting System at 10 p.m. (EST), February 25, and rebroadcast on most PBS stations at 6:30 p.m., February 28. Check local listings for exact time and date.

BULK RATE
U.S. POSTAGE
PAID
IBM CORP.